

## Article

# Hand hygiene knowledge and perception among the healthcare workers during the COVID-19 pandemic in Qassim, Saudi Arabia: A cross-sectional survey

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**Abstract:** Hand hygiene is among the most important factors of infection control in healthcare settings. Healthcare workers are considered the primary source of hospital acquired infection. We assessed the current state of hand hygiene knowledge, perception and practice among the healthcare workers in Qassim, Saudi Arabia. In this cross-sectional study we used the hand hygiene knowledge and perception questionnaire developed by the World Health Organization. Knowledge and perceptions were classified into good (80 – 100%), moderate (60 – 79%) and poor (<60% score). Majority of the healthcare workers had moderate knowledge (57.8%) and perception (73.4%) of hand hygiene. Males were less likely to have moderate/good knowledge compared to females (OR: 0.52,  $p < .05$ ). Private healthcare workers were less likely (OR: 0.33,  $p < 0.01$ ) to have moderate/good perception compared to the government healthcare workers. Healthcare workers who received training on hand hygiene were 3.2 times likely ( $p < .05$ ) to have good/moderate perception and 3.8 times likely ( $p < 0.05$ ) to routinely use alcohol-based hand-rub than the ones without such training. Physicians were 4.9 times likely ( $p < 0.05$ ) to routinely use alcohol-based hand-rub than the technicians. Our research highlighted gaps on hand hygiene knowledge and perception and practice among healthcare workers in Qassim and importance of training in this regard.

**Keywords:** healthcare workers; Hand hygiene; Saudi Arabia

## 1. Introduction

Hand hygiene is among the most important factors of infection control in a healthcare setting. Healthcare workers are considered the primary source of transmission of pathogens from one patient to the other through their contaminated hands [1]. Health care associated infections are a serious burden to the health care settings and a recent meta-analysis by US researchers reported that \$9.8 billion was spent yearly by the hospitals to combat with different types of hospital acquired infections [2]. Reduced hand hygiene compliance is considered to be a global problem and the compliance also differs among different health care professionals [3].

Hand hygiene is defined as the primary measure known to be effective in preventing healthcare-associated infections and preventing the spread of antimicrobial resistance [4]. Washing hands either with water and soap or using alcohol-based hand rub is the most cost-effective public health measure that can prevent health care-associated infections [1,5]. In 2009, WHO issued guidelines concerning hand hygiene procedures to reduce the prevalence of hospital-associated infections [6]. Though hand washing is a simple procedure, some healthcare workers are reluctant to adopt the recommended hand hygiene

practices. Poor compliance of the healthcare workers in following recommended hand hygiene procedures is associated with lack of adequate knowledge, awareness and attitude towards hand hygiene [6,7].

Healthcare workers have the responsibility to prevent cross-contamination, especially the nurses. Nurses are more likely to be responsible for transmission of infection causing microorganisms in the hospitals since they are higher in number and are the people who mostly come in contact with patients and contaminated objects [8,9]. Nursing interventions require the direct contact with patients, hence becoming an avenue for pathogen transfer if hand hygiene is not followed correctly [8,10].

According to the WHO, an estimated 1.4 million people globally are affected by healthcare-associated infections at any time [6]. There are many consequences associated with healthcare-associated infections– prolonged stay in the hospital, disability, higher healthcare cost for patients and families, increased morbidity and mortality and increased resistance to antibiotics. All these in turn increase financial burden on the health system [11]. Similar to the rest of the world, Saudi Arabia has a great concern about healthcare-associated infections. According to a study conducted in Saudi Arabian military hospital in the year 2004 about nosocomial infections, among 1382 patients who developed infection following hospital admission 48.3% had nosocomial infections [12]. Furthermore, a similar study conducted in KSA from 2010-2011 states that among the patients who developed infection following hospital admission, 48.3% of patients developed healthcare-associated infections; of all the healthcare-associated infections reported, there were respiratory tract infections (32.3%), urinary tract infections (25.3%), blood infections (18.2%) and surgical site infections (12.9%) [13]. Therefore, healthcare-associated infections are considered a significant public health concern for patients, healthcare workers and the health system [6]. In this context, the aim of this study was to evaluate the hand hygiene knowledge, perception and practices of the healthcare workers in Qassim, Saudi Arabia.

## 2. Methods

### 2.1. Study design, settings and sampling

We did a cross-sectional online survey of healthcare workers between October 2020 – March 2021 in Buraidah and Ar-ras cities of the Qassim region, KSA. An online structured survey form which was developed on the Google platform was disseminated to the healthcare workers in these two cities through our professional and social networks using emails and the WhatsApp. Study purpose and title was clearly indicated in the front page of the online page and the participants were requested to avoid multi-registration. A total of 301 healthcare workers completed the online survey.

### 2.2. The instrument

Our structured questionnaire had three parts. First part collected healthcare workers' socio-demographic information. The second and third parts collected information on healthcare workers' knowledge and perception of hand hygiene, respectively. To assess healthcare workers knowledge and perceptions on the essential aspects of hand hygiene we used the hand hygiene knowledge questionnaire [6] and the perception survey [14] for healthcare workers developed by the WHO.

### 2.3. Variables

To assess hand hygiene knowledge, for each correct response participants were given 1 point and 0 point for each wrong response. The overall knowledge was categorized into poor, moderate and good (80 – 100% score), moderate (60 – 79%), and poor if the score was less than 60%. We assessed perceptions of the healthcare workers on essential aspects of hand hygiene using 10 questions. Participants' response on each of these 10 questions were assessed with a five-point (0 – 4) Likert type scale–higher the score better the perceptions. We computed the total perceptions score and the overall perceptions was

categorized into good (80 – 100% score), moderate (60 – 79%), and poor if the score was less than 60%. For the multivariable logistic regression analyses we categorized knowledge and perceptions as moderate or good (60 – 100% score) and poor (<60% score). We assessed hand hygiene practice of the healthcare workers using a single item—whether or not the healthcare worker routinely used alcohol-based hand-rub while working.

#### 2.4. Analysis

We did descriptive analysis of the knowledge, perceptions and practice questions. We reported frequency and percentages for each of the knowledge, perceptions and practice items. We classified healthcare workers' knowledge and perceptions into good, moderate and poor. We reported number and proportions of the healthcare workers in each of these categories.

We did multivariable logistic regression analysis to investigate the factors associated with moderate to good knowledge, moderate to good perceptions and routinely using alcohol-based hand-rub. For multivariable logistic regression analyses we reported odds ratio (OR) with 95% confidence interval (CI). In addition, we reported corresponding *p* values. A *p* value of <0.05 was considered statistically significant.

### 3. Results

**Table 1.** Characteristics of the participants.

Characteristics	Frequency	Percent
<b>Type of health facility</b>		
Governmental	176	69.8
Private	76	30.2
<b>Gender</b>		
Female	133	44.2
Male	168	55.8
<b>Age</b>		
20-34 y	173	57.5
35 or over	128	42.5
<b>Nationality</b>		
Saudi	211	70.1
Non-Saudi	90	29.9
<b>Qualification</b>		
Graduate level	261	86.7
Postgraduate level	40	13.3

Table 1 shows the background characteristics of the health care workers in Qassim, Saudi Arabia. The background characteristics of the participants reveal that around 69.8% of health care workers are from government health facility whereas only 30.2% are from private health facility. Among all the health care workers, majority of them are males (55.8%) when compared to females (44.2%). Approximately, 57.5% of health care workers are under the age group of 20-34 years, followed by 35 or over age group (42.5%). According to the nationality, about 70.1% are from Saudi and the remaining 29.9% are non-Saudi. The health care workers with graduate level of qualification were 86.7% and only 13.3% were having postgraduate level of qualification.

Table 2. Hand hygiene knowledge of health-care workers in Qassim, Saudi Arabia.

Knowledge items (correct response)	Correct response	
	Frequency	Per cent
<b>The main route of cross-transmission of potentially harmful germs between patients in a health-care facility</b>		
HCWs' hands when not clean (Yes)	194	64.5
Air circulating in the hospital (No)	285	94.7
Patients' exposure to colonized surfaces (No)	223	74.1
Sharing non-invasive objects (i.e. stethoscopes, pressure cuffs, etc.) between patients (No)	288	95.7
<b>The most frequent source of germs responsible for health care-associated infections</b>		
The hospital's water system (no)	289	96.0
The hospital air (no)	276	91.7
Germs already present on or within the patient (yes)	85	28.2
The hospital environment (surfaces) (no)	122	40.5
<b>Hand hygiene actions prevents transmission of germs to the patient</b>		
Before touching a patient (yes)	284	94.4
Immediately after a risk of body fluid exposure (no)	41	13.6
immediately before a clean/aspetive procedure (yes)	258	85.7
After exposure to the immediate surroundings of a patient (no)	45	15.0
<b>Hand hygiene actions prevents transmission of germs to the health-care worker</b>		
After touching a patient (yes)	272	90.4
Immediately after a risk of body fluid exposure (yes)	272	90.4
Immediately before a clean/aspetive procedure (no)	43	14.3
After exposure to the immediate surroundings of a patient (yes)	261	86.7
<b>Alcohol-based hand-rub and hand washing with soap and water</b>		
Hand rubbing is more rapid for hand cleansing than handwashing (true)	197	65.4
Hand rubbing causes skin dryness more than handwashing (false)	214	71.1
Hand rubbing is more effective against germs than handwashing (true)	136	45.2
Handwashing and hand rubbing are recommended to be performed in sequence (false)	233	77.4
<b>The minimal time needed for alcohol-based hand-rub to kill most germs on hands (20 seconds)</b>	241	80.1
<b>Type of hand hygiene method required in the following situations</b>		
Before palpation of the abdomen (rubbing)	125	41.5
Before giving an injection (rubbing)	207	68.8
After emptying a bedpan (rubbing)	89	29.6
After removing examination gloves (rubbing)	129	42.9
After making a patient's bed (rubbing)	110	36.5
After visible exposure to blood (washing)	183	60.8
<b>Should be avoided, as associated with a likelihood of colonization of hand with harmful germs</b>		
Wearing jewelry (yes)	218	72.4
Damaged skin (yes)	272	90.4

Artificial fingernails (yes)	265	88.0
Regular use of a hand cream (no)	199	66.1
<b>Knowledge groups</b>		
Poor (<60% correct responses)	124	41.2
Moderate (60 – 79% correct responses)	174	57.8
Good (80 – 100% correct responses)	3	1.0

When participants were asked about their knowledge on hand hygiene issue, about 64.5% participants revealed that the main routes of cross-transmission between patients when their hands are not clean. Approximately 28.2% health care workers reported that germs already present on or within the patient are the main source of germs responsible for health care associated infections. About 94.4 % health care workers shared that hand hygiene action prevents transmission of germs before touching a patient. Also, a vast majority of the participants 90.4% and 88% respectively said that damaged skin and artificial fingernails should be avoided as associated with a likelihood of colonization of hand with harmful germs. Overall, about 57.8% health care workers have provided 60 to 79% correct responses.

**Table 3.** Perception of health-care workers about hand-hygiene.

Perception	Freq.	%
In general, what is the impact of a health-care-associated infection on patient's clinical outcome?		
very low	1	.3
Low	4	1.3
neither high nor low	6	2.0
high	99	32.9
very high	191	63.5
What is the effectiveness of hand hygiene in preventing health care-associated infection?		
very low	5	1.7
Low	2	.7
neither high nor low	7	2.3
high	83	27.6
very high	204	67.8
Among all patient safety issues, how important should hand hygiene be within your management priorities at your institution?		
very low priority	5	1.7
low priority	4	1.3
moderate priority	14	4.7
high priority	81	26.9
very high priority	197	65.4
<b>In your opinion, how effective would the following actions be to increase hand hygiene permanently in your facility?</b>		
Leaders and senior manager support and openly promote hand hygiene		
0 (Not effective)	5	1.7
1	4	1.3

2	17	5.6
3	107	35.5
4 (Very effective)	168	55.8

**The health-care facility makes alcohol-based hand-rub available at each point of care**

0 (Not effective)	5	1.7
1	6	2.0
2	12	4.0
3	123	40.9
4 (Very effective)	155	51.5

**Hand hygiene posters are displayed at point of care as reminders**

0 (Not effective)	2	.7
1	8	2.7
2	16	5.3
3	122	40.5
4 (Very effective)	153	50.8

**In your opinion, how effective would it be to increase hand hygiene permanently in your facility if each health-care worker receives education on hand hygiene**

0 (Not effective)	3	1.0
1	6	2.0
2	12	4.0
3	100	33.2
4 (Very effective)	180	59.8

**Clear and simple instructions for hand hygiene are made visible for every health-care worker**

0 (Not effective)	3	1.0
1	8	2.7
2	12	4.0
3	110	36.5
4 (Very effective)	168	55.8

**Health-care workers regularly receive the results of their hand hygiene performance**

0 (Not effective)	4	1.3
1	14	4.7
2	48	15.9
3	110	36.5
4 (Very effective)	125	41.5

**Patients are invited to remind health-care workers to perform hand hygiene**

0 (Not effective)	12	4.0
1	72	23.9
2	69	22.9
3	62	20.6

4 (Very effective)	86	28.6
<b>Perception groups</b>		
Poor (<60% correct responses)	49	16.3
Moderate (60 – 79% correct responses)	221	73.4
Good (80 – 100% correct responses)	31	10.3

Table 3 shows the perception of health care workers about hand hygiene. According to the health care workers perception, about 63.5% reported that the impact of health care associated infection on patient's clinical outcome is very high whereas only 0.3% reported as very low. Around 67.8% of their perception is very high about the effectiveness of hand hygiene in preventing health care associated infection whereas 0.7% of low perception. Among all patient safety issues, 65.4% of health care workers consider that hand hygiene should be of very high priority within management priorities at the institution, however 1.7% of them consider it as very low priority. To increase hand hygiene permanently in health facility, few actions should be taken such as leaders and senior manager support and openly promote hand hygiene which health care workers reported as very effective (55.8%), whereas there are few who felt it as not effective (1.7%). While coming to alcohol-based hand rub availability at each point of care in health care facility, around 51.5% of health care workers opined it as a very effective action in contrast 1.7% of them opined as a not effective measure. About 0.7% of health care workers opinion about hand hygiene posters displayed as reminders at point of care is ineffective whereas approximately 50.8% of their opinion was very effective. According to the health care workers opinion about receiving education on hand hygiene to increase hand hygiene permanently in their health facility is not effective for 1% of health care workers however majority of their opinion was very effective (55.8%). Similarly, the opinion of health care workers is very effective about clear and simple instructions for hand hygiene making visible for every health care worker (55.8%) and health care workers regularly receiving the results of their hand hygiene performance (41.5%). Another measure to increase hand hygiene was patients are invited to remind health care worker to perform hand hygiene, only 28.6% of health care workers opinion was very effective for this measure whereas 4% of their perception for this measure was ineffective.

**Table 4.** Determinants of hand hygiene knowledge, perception and practice among health-care workers in the Qassim region, KSA.

Factors	Moderate to good knowledge				Moderate to good perception				Routinely use alcohol-based hand-rub			
	<i>p</i>	OR	95% CI for OR		<i>p</i>	OR	95% CI for OR		<i>p</i>	OR	95% CI for OR	
			Lower	Upper			Lower	Upper			Lower	Upper
<b>Gender</b>												
Female		1				1				1		
Male	.044	0.52*	0.28	0.98	.461	0.71	0.28	1.78	.065	0.28	0.07	1.08
Age												
20 - 34 years		1.00				1.00				1.00		
> 34 years	.062	0.55	0.30	1.03	.716	1.18	0.49	2.86	.321	1.97	0.52	7.49
Profession	.190				.760				.266			
Technician		1.00				1.00				1.00		
Nurse	.394	0.65	0.24	1.75	.919	0.93	0.24	3.68	.091	3.87	0.80	18.62
Dentist	.409	1.83	0.44	7.68	.656	0.65	0.10	4.28	.998	-	-	-
Physician (MD)	.872	1.09	0.40	2.93	.933	1.06	0.26	4.25	.042	4.90*	1.06	22.75
Pharmacist	.278	2.09	0.55	7.92	.314	2.77	0.38	20.20	.088	6.13	0.76	49.22
Education												
Graduate		1.00				1.00				1.00		
Post-graduate	.162	0.53	0.22	1.29	.018*	0.27	0.09	0.80	.000	0.09*	0.03	0.31
Nationality												
Saudi		1.00				1.00				1.00		
Non-Saudi	.072	2.03	0.94	4.38	.341	1.69	0.58	4.93	.552	0.64	0.15	2.76
Types of healthcare facility												
Government		1.00				1.00				1.00		
Private	.677	1.13	0.63	2.06	.006*	0.33	0.15	0.73	.061	0.34	0.11	1.05
Hand-hygiene training												
Did not received		1.00				1.00				1.00		
Received	.599	1.23	0.56	2.71	.016*	3.19	1.24	8.21	.023	3.75*	1.20	11.67



We found no evidence of statistically significant association between hand hygiene knowledge and demographic and professional variables apart from gender. After adjusting for the effect of all demographic and professional variables included in the model, we found that males were 48% less likely to have moderate to good knowledge compared to females (OR: 0.52; 95% CI: 0.28 – 0.98;  $p < .05$ ).

Regarding the perception of hand hygiene we found evidence of statistically significant association with education, types of health-care facility and training. We found that health care worker with post graduate level education were less likely to have moderate or good perception (OR: 0.27; 95% CI: 0.09 – 0.80;  $p < .05$ ). We also found that health-care workers from the private facilities were 67% less likely (OR: 0.33; 95% CI: 0.15 – 0.73;  $p < .01$ ) to have moderate/good perception compared to the health-care workers from the government facilities. Regarding training on hand hygiene, we found that health-care workers who received training on hand hygiene were 3.2 times likely (95% CI: 1.24 – 8.21,  $p < .05$ ) to have good/moderate perception about hand hygiene compared to the ones who did not receive training.

Our multi-variable logistic regression analysis results suggest evidence of statistically significant association ( $p < .05$ ) between routinely using alcohol-based hand-rub and type of profession, level of education, and training. Physicians were 4.9 times likely (95% CI: 1.06 – 22.75;  $p < .05$ ) to routinely use alcohol-based hand-rub than the technicians, after adjusting for the effect of other variables. In addition, we found that health-care workers who received training on hand hygiene were 3.8 times likely (95% CI: 1.2 – 11.67;  $p < .05$ ) to routinely use alcohol-based hand-rub than the ones who did not receive such training.

#### 4. Discussion

Our study aimed to assess the hand hygiene knowledge, perception and practice among the healthcare workers in Qassim, KSA. The study findings revealed that about 58% of the healthcare workers have moderate knowledge of recommended hand hygiene, while 41% have poor knowledge. Moderate knowledge among health care workers in hospital settings are also reported in studies conducted in North Central Nigeria, Iran, India and Pakistan [15-18]. This could be a reason for concern as some studies found that hand hygiene practice remains low despite a good amount of knowledge [19].

The study participants also implied that wearing artificial jewelry, fingernails and damaged skins could be the sources of spreading germs in the hospital settings. A similar result was reported by Suen et al (2020) in Hong Kong [20], Rajcevic et al in Serbia(2012) and Maheshwari et al in Bhopal city, India(2014) [7].

Our multivariate regression analysis revealed an association between knowledge on hand hygiene and the gender of the healthcare worker. Our study has shown that a woman healthcare worker has comparatively better knowledge of hand hygiene than a man healthcare worker. This finding agreed with a cross-sectional study in Hong Kong, where female healthcare workers demonstrated significantly higher knowledge than male healthcare workers [20]. The study findings also reported that healthcare workers with post-graduation education are less likely to have moderate or good hand hygiene perception. Research has shown educational intervention is a significant predictor of good hand hygiene compliance and hand hygiene education courses are needed to improve the competency infection control issues among health care workers [21]. A qualitative study conducted in Iran among the healthcare workers found that the appropriate education positively affects hand hygiene behaviour and attitude [22]. We found that the healthcare workers who attended training activities on hand hygiene are more likely to have a better perception of the issue. This is consistent with other qualitative and quantitative research findings conducted in Turkey and Uttarakhand, India [19,23] Ay et al 2019). The importance of repeated hand hygiene training for the healthcare workers has already been emphasized to reduce hospital-acquired infections [7].

Previously it has been reported that physicians' perceptions and perceived effectiveness of hand hygiene to some extent vary from other health care professionals [24]. The

physicians of this study also have shown similar characteristics. They are more regularly using alcohol-based hand rubs to protect themselves from germs compared to other professional health care workers. This is also congruent with research done in Pakistan by Ahmed et al. in 2020 [15]. Rajcevic et al (2012) found that the health care workers have a low level of knowledge pertaining to alcohol-based formulations. However, evidence from a teaching hospital in India shared that understanding the importance of hand hygiene is an essential driving factor among the health care professionals to regularly maintain the practice [25].

In this study, it is evident that moderate knowledge among the health care workers is the main barrier to maintain good hand hygiene practice at workplace. More repeated training courses and a culture of promoting good hand hygiene practice should be promoted frequently. The main limitation of the study is that the data has been gathered from only one hospital setting and due to the cross-section nature of the study, the findings of the cannot replicated for a similar larger population group. However, the findings of the study would be useful for the hospital authorities to take extra precautions and should make necessary arrangements to provide extra support on a regular format to the health care professionals who are working at the front line to deal with any emergency arises.

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