




# Knowledge, Attitude and Self-Reported Performance and Challenges of Hand Hygiene Using Alcohol-Based Hand Sanitizers Among Healthcare Workers During COVID-19 Pandemic at a Tertiary Hospital: A Cross-Sectional Study

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**Background and Objective:** Understanding and consistent hand hygiene practice by alcohol-based hand sanitizer is a cardinal step to stay safe from the coronavirus disease (COVID-19) pandemic. This study aimed to assess the self-reported level of knowledge, attitude, practice, and challenges to practice hand hygiene by alcohol-based hand sanitizers among healthcare workers during the COVID-19 pandemic in Jimma Medical Center, Ethiopia.

**Methods:** Between April and June 2020, a questionnaire-based descriptive cross-sectional study was conducted using 96 study participants. Data were analyzed using SPSS version 21 and described.

**Results:** All of the study participants (96) were at the forefront of the fight against COVID-19. Most of the study participants were nurses (27) and pharmacists (21). Their mean age was  $28.69 \pm 4.048$  years. All of them were practicing different COVID-19 prevention methods. In this study, 95.8% of the respondents used alcohol-based hand sanitizers. The majority of the respondents were knowledgeable (93.8%), had a favorable attitude (74%), and good hand hygiene practices (76%) by alcohol-based hand sanitizers. However, 84.5% of the respondents were confronted with challenges during alcohol-based hand sanitizer use due to it is unavailable 66 (68.8%), expensive 50 (52.1%), forgetting 11 (11.5%), experiencing health-associated risks (skin irritation (28.1%), skin dryness (62.5%), ocular irritation (11.5%)), etc.

**Conclusion:** The majority of respondents had good knowledge, attitude, and practices of alcohol-based hand sanitizer. But there were some items of their evaluation with relatively low scores that revealed some room for improvements. Additionally, the respondents reported various challenges. Therefore, to achieve and sustain changes, the hand hygiene promotion strategic plan needs a great concern.

**Keywords:** coronavirus disease, hand hygiene, alcohol-based hand sanitizer, healthcare worker

## Background

Coronavirus disease (COVID-19) is a respiratory illness and was declared a global pandemic by the WHO on March 11, 2020. Since its emergence, it is spreading rapidly over the world and became a global health crisis of our time. These crises

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are devastating social, health, economic, and political problems that will leave deep scars.<sup>1–3</sup>

Coronavirus disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Humans are the common transmission source of SARS-CoV-2 through human to human interactions (through respiratory droplets or contact).<sup>4–6</sup> Transmission occurs when the hands contaminated with the virus touch the mucosa of a healthy person's mouth, nose, or eyes. The infected persons can transmit the virus even when they have no, or only mild, symptoms.<sup>3,7,8</sup>

So far, no medication therapy is available to manage COVID-19. Preventing spread is therefore extremely important to reduce the overall burden of the disease and to remain safe. Currently, WHO recommends physical distances, appropriate use of all personal protective equipment (such as masks, goggles, etc), and hand hygiene (HH) practices to reduce the spread.<sup>7</sup>

Practicing HH, which includes the use of alcohol-based hand sanitizer (ABHS) or handwashing with soap and water, is a simple and yet effective way to prevent the spread of COVID-19 in healthcare settings.<sup>9,10</sup> Unless hands are visibly soiled, ABHS is recommended by the WHO over handwashing with soap and water in most clinical situations. It should be due to ABHS is time and cost-effective, available at the point of care, has improved skin tolerance and has a broad microbiological spectrum. The ABHS should contain at least 60% ethanol or 70% isopropanol to kill the COVID-19 virus.<sup>11–14</sup>

Following the outbreak of COVID-19, the popularity of ABHS in the community and healthcare settings has been increasing. But, different studies had been done before the COVID-19 outburst and showed that overall compliance with HH by ABHS was poor in developing countries. Additionally, it is hard to promote by using the WHO multi-modal strategy.<sup>15,16</sup>

Especially healthcare workers (HCWs) were highly ABHS users during this COVID-19 pandemic time. Therefore, their knowledge, attitudes, challenges, and compliance with practicing ABHS at the five essential moments recommended by the WHO can affect the safety of them and their staff clients and community. Therefore, it is essential to study this situation to enhance the development of appropriate strategies to promote HH for users in the future. So, the present study was focused on identifying gaps and strengths by assessing the self-reported level of knowledge, attitude, practice, and challenges to practice WHO recommended HH procedures by ABHS among

HCWs during the COVID-19 pandemic in Jimma Medical Center (JMC), Ethiopia.

## Methods

### Study Setting, Design, and Period

A hospital-based descriptive cross-sectional study design was conducted between April 01 and June 27, 2020. The study area was at JMC. JMC is one of the oldest hospitals in Ethiopia, and the only teaching and referral hospital in southwest Ethiopia. It has an 800-bed capacity and a catchment population of over 15 million people. More than 400,000 patients can be served at emergency, outpatient departments, and various inpatient units per budget year.

### Eligibility Criteria

The volunteer HCWs who served a health institute for a minimum of 1 year, working in JMC, and  $\geq 18$  years of age during the study period were eligible to participate in the study.

### Survey Population, Sample Frame, Sample Size, and Sampling Method

The survey populations were HCWs, such as clinical nurses, pharmacists, academicians, medical laboratory technologists, physicians, dental doctors, and midwives, working in JMC. The sample frame was HCWs who were on duty at JMC during the study period. The study participants were all HCWs who were on duty in the months of data collection and agreed to participate in the study. The response rate was low due to data collection was paper-based, and it can be the means of COVID-19 virus transmission. Therefore, the sample size was only 96 HCWs. The convenience sampling method was used based on the HCWs' availability at the work area and willingness to participate in the study.

### Data Collection Tool and Procedures

Data collection was done with well structured, pretested, and self-administered English questionnaire. The self-reported questionnaire included questions prepared on participant demographics, HH by ABHSs' knowledge, attitudes, practices, and challenges on performing it. It was developed by using the WHO guidelines and other references.<sup>9–12,14–18,21–26</sup>

The data collectors were four trained health professionals. They were trained on the objectives of the study and the contents of the data collection checklist. The

voluntary participants who agreed to cooperate with the study were asked for verbal agreement. Then, data collectors delivered a developed data collection checklist to the study participants when they were at the work area and collected it soon after filled. Strict supervision by the principal investigators was conducted during data collection to prevent selection bias.

## Study Variables and Measurements

The study participants' knowledge, attitude, practice, and common challenges of HH by ABHSs were assessed and described using qualitative terms of self-evaluation. The self-reported questionnaires were developed from previous studies.

The self-reported knowledge of the respondents about ABHSs for COVID-19 prevention was evaluated by using terms like agree, disagree, and not know the approved facts. Then, the respondents were categorized as knowledgeable and not knowledgeable. The study participant who agreed with the facts on the WHO guidelines on HH in health care (received 1 point) and replied correctly (agree)  $\geq 50\%$  of the knowledge questions were considered as knowledgeable.<sup>9–12,15</sup>

The attitude questionnaire aimed mainly at studying the attitude of HCW towards methods of improvement of handwashing practice in their workplace. For attitude description, terms like strongly agree, agree, neutral, disagree, and strongly disagree were used. The study participants who agreed or strongly agreed to the facts listed on the WHO guidelines (received 1 point) and replied  $\geq 50\%$  of the attitude questions correctly were considered as having a good attitude. Those who replied neutral, disagree, or strongly disagree with the facts listed on the WHO guidelines (received 0 point) and responded  $< 50\%$  correctly (agreed or strongly agreed) were considered as having a poor attitude.<sup>9,10,17</sup>

For evaluation of self-reported hand hygiene practices or compliance, five questions were developed based on WHO's 'My five moments for hand hygiene (before patient contact, before clean/aseptic procedures, after the risk of body fluids, after patient contact, and after contact with patient surroundings).<sup>9</sup> Respondents were asked to choose from five options-always, often, sometimes, seldom, or never.

The study participants who believe that they always practice ABHS for HH at the five essential moments (received 1 point) and correctly (always) replied  $\geq 50\%$  of the compliance questions were considered as compliant.

And those who practice ABHS often, sometimes, seldom, or never (received 0 point) and responded  $< 50\%$  correctly (always) were considered as non-compliant.<sup>17,18,20–23,25,26</sup>

A higher score in each domain (knowledge, practice, and attitude) indicated greater knowledge, more frequent performance, and better attitudes.

For the assessment of challenges to the practice of HH by ABHSs at the five essential moments in health care, according to the recommended handwashing practice, were evaluated. The questions were developed using related references were used.<sup>14,23–26</sup>

## Data Quality Assurance and Analysis

After the pretest, the questionnaires were revised for clarity and consistency. All filled questionnaires were checked regularly for completeness individually.

Data entry, data checking, and data analysis were done with the program Statistical Package for Social Sciences (SPSS) version 21. The level of significance was set at 5% ( $p < 0.05$ ). Descriptive statistics for socio-demographic characteristics, hand hygiene knowledge level, and hand hygiene practices of the respondents were reported. Categorical variables were described by frequencies and percentages and presented in a table, figure, and paragraph.

## Ethics Approval and Informed Consent

Before the commencement of the study, the written proposal was presented to Jimma University Institutional Review Board for approval. The Institutional Review Board evaluated the document and waived the requirement for the documentation of written informed consent and allowed investigators to obtain verbal informed consent. Then, before the administration of the questionnaire, the data collectors explained all pertinent information (purpose, risks, benefits, alternatives to participation, etc.) for study participants and allowed them the opportunity to ask questions. Then, verbal agreement to participate in the research was obtained from the volunteers, and data collected. The collected data were kept confidential and maintained locked throughout the study. Only the principal investigators and co-authors had access to the data. This study was conducted in accordance with the Declaration of Helsinki.

## Operational Definition

Academician: Health professionals giving health services in JMC and/or academic activity at Jimma University

Hand hygiene: a behavior of cleaning the hands with soap and water and by hand-rubbing using hand sanitizer without water

Handwashing: washing hands with plain or antimicrobial soap and water

Knowledge: having an adequate understanding of hand hygiene.

- Knowledgeable: earning a score of 50% and above on the knowledge questions indicating having a sufficient amount of knowledge
- Not knowledgeable: earning score of less than 50% on the knowledge questions

Practice: an act of performing a given procedure(s) according to a set standard.

- Good practice: study participants who responded to the practice questions  $\geq 50\%$  in line with the recommended handwashing practice
- Poor practice: study participants who responded to the practice questions  $< 50\%$  in line with the recommended handwashing practice

Attitude: the belief of the respondents towards the facts on the WHO guidelines on HH in health care.

- Good/favorable attitude: those who agree and strongly agree to the facts and responded  $\geq 50\%$  correctly to the attitude questions
- Poor attitude: who responded  $< 50\%$  correctly the attitude questions

## Results

### Demographic Characteristics of Enrolled Healthcare Workers

Of the total JMC HCWs on duty in the months of data collection, 96 of them have participated in this study. Majority of the respondents were clinical nurses 27 (28.1%); followed by pharmacists 21 (21.9%), academicians 15 (15.6%), medical laboratory technologists 13 (13.5%), physicians 7 (7.3%), dental doctors 7 (7.3%) and midwives 6 (6.3%), respectively. Their mean age was  $28.69 \pm 4.048$  years (Table 1). Following the outbreak of COVID-19, 39 (40.6%) of them were taken training on the measures for preventing COVID-19 transmission.

### Commonly Used COVID-19 Pandemic Prevention Techniques

Since the outbreak of COVID-19, all the study participants have been at the forefront of the fight against this extremely contagious infectious disease. All of them were using different COVID-19 prevention methods. None of them were using a single method only (Table 2).

### Self-Reported Knowledge of Respondents About Hand Hygiene by Alcohol-Based Hand Sanitizer

To prevent the spread of the COVID-19 pandemic, HCWs generally considered and practiced HH by ABHSs and handwashing with soap and water as an effective intervention. However, they had a different level of knowledge about HH by ABHS (Table 3).

### Self-Reported Knowledge of Respondents on Alcohol-Based Hand Sanitizers Storage Condition

To keep the quality, safety, and effectiveness of ABHS, the respondents had a different level of knowledge on storage condition selection before and after use (Figure 1).

**Table 1** Demographic Characteristics of Enrolled Healthcare Workers

Variables		Frequency, n (%)
Age (years)	18–24	8
	25–35	82 (85.4)
	>35	6
Sex	Male	61 (63.5)
	Female	35 (36.5)
Religion	Orthodox	44 (45.8)
	Protestant	36 (37.5)
	Muslim	15 (15.6)
	Other	1
Marital status	Married	52 (54.2)
	Single	44 (45.8)
Current education level	Degree	67 (69.8)
	Master/ Specialty	27 (28.1)
	PhD	2
Years spent in the healthcare setting	<5	73 (76)
	5–10	19 (19.8)
	>10	4

**Table 2** COVID-19 Prevention Methods Practiced by Enrolled Healthcare Workers

S. No.	COVID-19 Prevention Techniques Used	Frequency (%)
1	Handwashing with soap and water	93 (96.9)
2	Alcohol-based hand sanitizers	92 (95.8)
3	Physical distancing	87 (90.6)
4	Non-pharmaceutical equipment (mask, glove)	78 (81.3)
5	Both handwashing with water and soap and alcohol-based hand sanitizers	62 (64.6%)

According to the present study, most of the study participants got information about the use of ABHS to prevent COVID-19 and its storage condition from the

**Table 3** Level of Respondent's Knowledge Concerning Hand Hygiene by Alcohol-Based Hand Sanitizers

Statement About Hand Hygiene by ABHS	Responses n (%)	
	Knowledgeable	Not Knowledgeable
HH is required even when gloves are used to touch patients.	88 (91.7)	8 (8.3)
If the hands are visibly dirty, ABHS cannot be used for HH alone.	79 (82.3)	17 (17.7)
Removal of dirt can increase the effectiveness of ABHS.	82 (85.4)	14 (14.5)
Both hands should be dried before using ABHS.	85 (88.5)	11 (11.4)
The minimal time needed for ABHS to kill the COVID-19 virus on your hands is 20 seconds.	75 (78.1)	21 (21.9)
Using ABHS for HH is less time-consuming, at least as efficient, and convenient than handwashing with soap and water.	70 (72.9)	26 (27.1)
Poor adherence to HH practice is a primary contributor to spreading of COVID-19.	84 (87.5)	12 (12.5)
ABHS causes skin dryness more than handwashing with water and soap.	74 (77.1)	22 (22.9)

**Notes:** Knowledgeable: participants who replied correctly (agree with the facts on the WHO guidelines)  $\geq 50\%$  of the knowledge questions.

mass media 71 (74%); followed by books and published journals 33 (34.4%), discussion with co-workers 26 (27.1%), presence of posters for HH in the work area 14 (14.6%) and seminars conducted occasionally at hospital level 11 (11.5%).

## The Self-Reported Attitude of Respondents Towards Hand Hygiene by Alcohol-Based Hand Sanitizers

According to the participants' reply to questions used to evaluate the attitude, the entire study participants had favorable attitudes toward HH by ABHSs (Table 4).

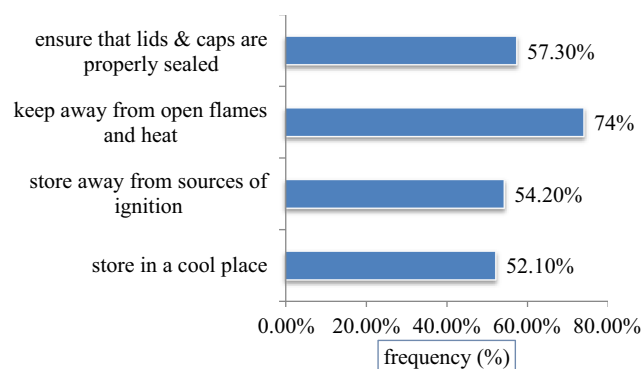
## Self-Reported Compliance of Respondents to the WHO Recommended Alcohol-Based Hand Sanitizers Practices

Following the WHO's current recommendation, compliance with ABHS uses at the five essential moments for HH per a single care sequence by HCWs had a gap and needed a concern (Table 5).

Most of the study participants (63 (65.6%)) are compliant with the ABHS duration of hand sanitizer recommended by the WHO (20–40 seconds).<sup>15</sup> The others were non-compliant to the WHO recommendation (<20 sec= 29 (30.2%), >40 sec= 4(4.1%)).

## Self-Reported Challenges During Alcohol-Based Hand Sanitizer Use

The present study finding showed that the majority of the respondents reported difficulties that might hinder the frequent and effective use of ABHR according to recommended by the WHO (Table 6).

**Figure 1** Knowledge of the respondents about the storage conditions for alcohol-based hand sanitizers.

**Table 4** The Self-Reported Attitude of Respondents Towards Hand Hygiene by Alcohol-Based Hand Sanitizers

Statements for Attitudes Evaluation		Response, n (%)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You have sufficient knowledge about HH.		5	6	3	48 (50)	34 (35.4)
You work in a health facility where HH is encouraged.		4	3	7	56 (58.3)	26 (27.1)
You feel competent in using ABHS following WHO recommendations.		5	8	15 (15.6)	48 (50)	20 (20.8)
You believe that you are the front-line professional to create awareness of HH practice.		3	5	12 (12.5)	49 (51)	27 (28.1)
You believe that you are one of the most accessible HCWs to patients.		2	11 (11.5)	12 (12.5)	45 (46.9)	26 (27.1)
The frequency of HH required does not make it difficult to carry out ABHS as often as necessary.		8	41 (42.7)	16 (16.7)	26 (27.1)	5
There is no time pressure for not attending HH courses.		5	21 (21.9)	17 (17.7)	36 (37.5)	17(17.7)
Your HH practice can be further improved.		4	8	12 (12.5)	50 (52.1)	22 (22.9)
If ABHS is provided, it is not difficult for you to use it even if ABHS	Residual is not pleasant	3	16 (16.7)	13 (13.5)	48 (50)	16 (16.7)
	Irritates your skin	2	25 (26)	11 (11.5)	41 (42.7)	17 (17.7)
	Is not easy to use	5	7	8	54 (56.2)	22 (22.9)

**Note:** Those who replied  $\geq 50\%$  of the attitude questions correctly were considered as having a good attitude.

## Discussion

Following its outbreak, the alarmingly spread of COVID-19 is becoming a major global threat. Mainly HCWs are one of the highly exposed groups and had the likelihood of acquiring this disease. During the study period, there is no treatment discovered and no vaccine supply in Ethiopia. So to stay safe, HCWs practice prevention measures as the best solution. Therefore, effective prevention can be achieved through increasing their knowledge, attitude, and practice towards COVID-19 prevention and solving the challenges.

The current study assessed the knowledge, attitudes, practice, and challenges of HCWs regarding COVID-19 prevention and control. The survey data of this study demonstrated that all of the enrolled HCWs were using different prevention techniques. Commonly, they used

hand hygiene (Table 2). The results might reveal that HCWs were practicing WHO recommended prevention techniques and had information on the global health crisis of COVID-19.<sup>2,19</sup> The reasons for these positive results might include: the respondents' educational status, their exposure to a lot of information about COVID-19 through different media, their responsibility to adhere to scientifically accepted and evidence-based principles of infection control, and the time of data collection period were during the pandemic got the attention.

The current study demonstrated that most of the HCWs were preferred and using ABHS with different justifications. The majority (93.8%) of the respondents had good knowledge about HH by ABHS uses to prevent and control the spreading of COVID-19 (Table 3). These results support recommendations reported by WHO<sup>15</sup> and Oliveira et al (2017).<sup>25</sup>

**Table 5** Self-Reported Compliance of Respondents to Hand Hygiene Using Alcohol-Based Hand Sanitizers

Compliance Evaluation: When to Use ABHS?	Frequency of Use, n (%)				
	Always	Often	Sometimes	Seldom	Never
Before touching a patient	70 (72.9)	11 (11.5)	15 (15.6)	–	–
Before clean procedure	70 (72.9)	14 (14.6)	9 (9.4)	1	2
After body fluid exposure risk	80 (83.3)	9 (9.4)	6 (6.3)	–	1
After touching a patient	82 (85.4)	7 (7.3)	6 (6.3)	–	1
After touching patient surroundings	80 (83.3)	8 (8.3)	6 (6.3)	1	1

**Table 6** Self-Reported Challenges Against Frequent and Effective Use of Alcohol-Based Hand Sanitizers

Challenges	Frequency, n (%)
Unavailability of ABHSs	66 (68.8)
Costly	50 (52.1)
Forgetting	11 (11.5)
Skin damage	8 (8.3)
Unpleasant taste	3 (3.12)
Wearing glove	3 (3.12)

The current study revealed that the answers to the following questions find comparatively more deficiency in the awareness of the respondents. The questions were using ABHS for HH is less time-consuming, efficient, convenient, and causes more skin dryness than handwashing with water and soap. Also, fewer than 75% of the study participants were aware of the standard storage condition recommended by the WHO (Figure 1). Therefore, HH education programs should be promptly re-viewed, and training programs should be developed and implemented.

In the present study, univariate (binary logistic regression) analysis indicated that HCWs' knowledge about HH by ABHS was not statistically associated with the sex difference (COR 0.552; 95% CI 0.105–2.894;  $P=0.482$ ) and years spent in a healthcare setting (COR 0.618; 95% CI 0.068–5.580;  $P=0.668$ ). Multivariate analysis showed that HCWs who took training on COVID-19 prevention techniques were more than three times knowledgeable than untrained (AOR 3.65; 95% CI 0.41–32.56;  $P=0.246$ ) (Table 7).

In the present study, most of the respondents (74%) had a favorable attitude towards their knowledge and practice of HH, mainly by ABHSs and the requirement of ABHSs in the work area. A similar finding was reported by a study done in a tertiary hospital, South West Nigeria (2011).<sup>17</sup> The similarities might be due to the similar educational status and awareness of the study populations and similarities of the information. However, most of the respondents felt that their HH practice needed improvement. Some perception-related items that won relatively low scores should therefore be strengthened to maintain good HH.

According to this study's results, univariate or multivariate statistical analysis (accordingly) showed that study participants' differences in sex ( $p=0.96$ ), age ( $p=0.39$ ), years spent in a healthcare setting ( $p=0.57$ ), and current

education level ( $p=0.35$ ) did not have a statistically significant association with their attitude towards HH by ABHS (Table 7). Although not statistically significant, respondents considered knowledgeable had a better attitude to ABHS than not knowledgeable (COR 0.676; 95% CI 0.118–4;  $P=0.676$ ).

The results of the current study showed that the majority of study participants (76%) were in line with the WHO suggested procedures. It showed more compliance to ABHS use at the five moments for hand hygiene than with other studies conducted at the University of Gondar teaching hospitals (2019)<sup>23</sup> and in a tertiary university hospital in Istanbul (2014).<sup>24</sup> The reason for this discrepancy might be due to the difference in sample size and study time. Additionally, the outbreak of COVID-19 may contribute to HCWs' awareness of ABHS use.

Furthermore, self-evaluation of HH by ABHS showed that the lowest compliance was reported at using ABHS before touching a patient and before a clean procedure. This result of the present study (before touching a patient) was in line with the finding of a study conducted by Li et al (2015) in Inner Mongolia, China.<sup>27</sup> The similarity might be due to similar educational status and awareness of the study populations.

The current study showed that compliance to HH by ABHS did not statistically vary with respondents' age, taking training, current education level (Table 7). In univariate analysis, non-compliance with HH was not significantly associated with sex (COR 1.101; 95% CI 0.413–2.935;  $P=0.848$ ). This finding agrees with a study conducted in a tertiary university hospital in Belo Horizonte, Brazil (2015).<sup>25</sup> It might be due to not a sufficient number of samples were used to identify the association.

In multivariate analysis, there was a statistical association between compliance to the five moments of HH recommended by WHO and attitude towards HH by ABHS (AOR 2.974; 95% CI 1.093–8.093;  $P=0.033$ ). As a result, those who had a positive attitude had more than two times more compliance than the others. But there was no difference in compliance due to knowledge of ABHS use and compliance to practice it accordingly (COR 0.286; 95% CI 0.053–1.526;  $P=0.143$ ). This finding is not consistent with a study conducted in the Central Gondar Zone public primary hospitals, where knowledgeable study participants are 6.74 times more compliant than those with poor knowledge. The difference might be due to the sample size issue and study time (COVID-19 pandemic time).

**Table 7** Factors Related to Poor Knowledge, Attitude, and Practice of Hand Hygiene

Variables		Knowledge		COR(95% CI)	p-value	AOR (95% CI)	p-value		
		Knowledgeable	Not Knowledgeable						
Sex	Male	58	3	1					
	Female	32	3	0.55(0.11–2.89)	0.48				
Years spent in healthcare setting	<5	68	5	0.62(0.07–5.58)	0.66				
	≥5	22	1	1					
Training*	Yes	38	1	1					
	No	52	5	0.27(0.03–2.44)	0.25			3.65(0.4–32.56)	0.25
Attitude		Good attitude	Poor attitude						
Sex	Male	45	16						
	Female	29	9	1.03(0.40–2.65)	0.96				
Age	18–30	58	23	0.39(0.08–1.86)	0.24			2.06(0.40–10.5)	0.39
	>30	13	2	1					
Years spent in the healthcare setting	<5	55	18	1.34(0.48–3.77)	0.57				
	≥5	16	7	1					
Training*	Yes	31	8	1					
	No	40	17	0.61(0.23–1.59)	0.310				
Current education level	Degree	47	20	0.49(0.16–1.47)	0.20	1.73(0.55–5.44)	0.35		
	Masters & above	24	5	1					
Compliance		Compliant	Non-complaint						
Sex	Male	46	15						
	Female	27	8	1.10(0.41–2.94)	0.85				
Age	18–30	60	21	0.44(0.09–2.11)	0.31				
	>30	13	2						
Training*	Yes	28	11						
	No	45	12	1.47(0.57–3.79)	0.42				
Years spent in a healthcare setting	<5	51	22	0.11(0.01–0.83)	0.03	8.00(0.99–64.08)	0.05		
	≥5	22	1						
Current education level	Degree	47	20	0.27(0.07–1.0)	0.05	2.98(0.78–11.34)	0.11		
	Masters & above	26	3						

**Notes:** Age and current education level do not fulfill the assumption to analyze the knowledge of HCWs due to inadequate sample size. \*Training taken on techniques to prevent COVID-19 virus transmission.

**Abbreviations:** NA, not applicable (only variables with p values <0.25 on univariate were put into multivariate regression model); COR, corrected odds ratio; AOR, adjusted odds ratio.

A complex interplay of cognitive, socioeconomic, and technical factors may determine hand-washing practice among hospital-based HCWs. In this study, self-reported reasons for frequent lack of compliance to ABHS use included the following: lack of ABHS, increasing cost, experienced health risks, forgetting wearing the glove, and others. Lack of ABHS and increasing cost were the most common (Table 6). This finding is in line with a study conducted in Ruth K.M. Pfau Civil Hospital, Karachi (2019),<sup>26</sup> but higher than a result from the study conducted in a tertiary university hospital in Istanbul (2014).<sup>24</sup> The difference should be due to the more consumption of ABHS, in the healthcare setting and community, during the study period. During this study period, there was an outbreak and rapid prevalence of the COVID-19 pandemic.

According to the present study, most study participants experienced different health risks, commonly skin dryness, skin irritation, unpleasant taste, ocular irritation, cough, gastrointestinal disturbances, and others. This result agrees with a study conducted in a tertiary university hospital in Belo Horizonte, Brazil (2015)<sup>25</sup> and Inner Mongolia, China (2015)<sup>27</sup> These risks become one of the reasons for not adhering to the WHO recommended “My five moments for hand hygiene” to use ABHS by 8 (8.5%) respondents.

## Strength and Limitation of the Study

The present study characterized the HH knowledge, attitudes, and challenges of performing HH by ABHS and identified gaps that are essential to control outbreaks (COVID-19). It provided substantial evidence to facilitate the development and implementation of an action plan for strengthening the program for the proper use of ABHS to prevent the risks. These data also showed the need for training to enhance compliance with the use of ABHS. Furthermore, the data can be used for further analysis by the scientific community.

This study is subject to limitations. As this study was not observational, this study has some limitations in terms of the self-reporting of HH performance and volunteer bias. What the study participants respond can be different from what they practice in real-life situations. Additionally, the number of study participants was not sufficient to distinguish statistically significant results and may be challenging to generalize the findings of the study.

## Conclusion

Most HCWs performed HH by ABHS to prevent and monitor the transmission of the COVID-19 virus. Most of them had good self-reported knowledge and attitude toward using ABHS. There was no clear evidence showing a disparity in HCW’s knowledge and attitude towards using ABHS for HH due to sex and years of experience difference. However, study participants considered as knowledgeable had a favorable attitude towards HH by ABHS. Additionally, those who took training on COVID-19 prevention techniques had more than three times knowledgeable than untrained. Also, most of the respondents adopted the HH practice by ABHS at the five essential moments recommended by the WHO. The level of compliance significantly depends on years spent in the healthcare setting. Furthermore, the lack of ABHS and the increase in its cost were reported as the most common reasons for not using ABHS as needed. Additionally, reported skin irritation, unpleasant taste, and skin dryness as ABHS health risks were reported and may contribute to the compliance problem. Generally, there were some knowledge, attitude, and practice evaluation items with relatively low scores that showed some room for improvement.

## Recommendation

The present study identified the vital gaps of HCWs’ knowledge and attitude, and non-compliance on certain occasions, as well as challenges to the success of HH by ABHS according to WHO guidelines. They warranted some room for improvements. Therefore, the authors suggested multiple strategies (multimodal and multidisciplinary approach). So the regular and public bodies should catalyze local production and supply of low irritating ABHSs (containing emollients) according to the WHO guideline, systemic and advanced HH training programs to enhance awareness, promote compliance, and behavioral change toward HH.

## Abbreviations

ABHS, alcohol-based hand sanitizer; COVID-19, coronavirus disease; HH, hand hygiene; HCW, healthcare worker; JMC, Jimma Medical Center.

## Data Sharing Statement

The data used to support the findings of this study are available from the corresponding author upon request.

## Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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