

# Knowledge, Attitude and Practices of Hand Hygiene among Students and Nurses Staff in Mwanza Tanzania: A Cross-Sectional Hospital-Based Study during Global COVID-19 Pandemic

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## ABSTRACT

**Background:** Hand hygiene (HH) is a critical component of infection prevention and control (IPC) which aims at preventing microbial transmission during patient care hence reducing the burden of healthcare associated infections (HCAIs). Information on the level of HH knowledge, attitudes and practices among healthcare workers (HCWs) from low- and middle-income countries is scarce. This study determined knowledge, attitude and practices of HH among students and staff nurses in Mwanza, Tanzania.

**Methods:** This cross-sectional hospital-based study was conducted between August and October 2020 among student and staff nurses from 2 health centres, 2 district hospitals, 1 regional referral hospital and 1 zonal referral hospital. Self-administered pretested structured questionnaires were used for data collection. All data was transferred to Microsoft excel spreadsheet for cleaning and coding, then to STATA software version 13.0 for analysis.

**Results:** A total of 726 nurses aged 18 to 59 years with median (IQR) age of 29(24-38) years were enrolled. About 3 quarters 76.4% (555/726) of nurses had good level of knowledge on HH as most of them 88.3% (641/726) had received rigorous IPC trainings during COVID-19 pandemic. About 42.0% (305/726) of the participants reported that, the action of HH was effortless. Majority of the participants, 81.1% (589/726) practiced hand washing more than hand rubbing routinely. Being a student nurse [OR: 0.30, 95%CI: 0.21-1.44,  $p < .001$ ], working in inpatient department [OR: 0.38, 95%CI: 0.27-0.55,  $p < .001$ ], high level of education i.e., degree and above [OR: 1.74, 95%CI: 1.36-2.24,  $p < .001$ ] and having working experience of 5 years and above [OR: 2.41, 95%CI: 1.52-3.82,  $p < .001$ ] was associated with being knowledgeable of HH.

**Conclusion:** Majority of the participants had good level of knowledge on HH because they had received rigorous training on IPC, notably HH during the global COVID-19 pandemic.

## INTRODUCTION

Hospital Acquired Infections (HAIs), also known as nosocomial infections or health care-associated infection (HAIs) are defined by the World Health Organization (WHO) as infections occurring in a patient during the process of care in a hospital or other health care facility, which were not present or incubating at the time of admission. This includes infections acquired in the health care facility, but appearing after discharge, and also occupational infections among Health Care Workers (HCWs) of the facility.<sup>1, 2</sup> The acquisition of an infectious agent causing HAI is aided by 3 factors, namely: 1) source of the organism e.g., contaminated hospital environment, 2) presence of a susceptible host e.g., patient with impaired anatomical barriers and 3)

mode or vehicle of transmission of the infectious agent to susceptible host i.e., contaminated hands of healthcare workers (HCWs).<sup>3</sup> Most HAIs can be prevented by simple measures of Infection Prevention and Control (IPC) such as Hand Hygiene (HH).<sup>3</sup> Practicing HH by using alcohol-based hand rub for 20 to 30 seconds or hand washing with running clean water and soap for 40 to 60 seconds is very effective against pathogens causing HAIs including Multidrug Resistant (MDR) pathogens.<sup>4</sup> Alcohol-based hand rub is recommended when hands are not visibly soiled while washing hands with running clean water and soap is recommended when hands are visibly soiled with blood or other body fluids.<sup>4</sup> In 2009, the World Health Organization (WHO) introduced the 5 moments of HH in healthcare facilities.<sup>4</sup> These include; 1. before touching a patient; 2. before clean/

aseptic procedure, 3. after body fluid exposure/risk; 4. after touching a patient; and 5. after touching patient surroundings.<sup>4</sup> These moments of HH aims at preventing the transmission of pathogens between patients, from patients to HCWs and vice versa, from patients to hospital environment and from contaminated hospital environment to patients.<sup>4</sup>

In most low- and middle-income countries, the level of knowledge as well as attitude and practice of HH among HCWs is reportedly poor. Inadequate HH facilities and lack of adequate and appropriate training are the major factors contributing to poor knowledge, attitude and practice of HH among HCWs.<sup>5</sup> In Nigeria, about 55.8% and 68.8% of HCWs washed their hands before patients' palpations and giving injections, respectively.<sup>6</sup> In Ethiopia, about 65.9% of HCWs are reported to be knowledgeable about HH and 56% have poor practices of HH.<sup>7</sup> In Tanzania, Wieden mayer *et al.*, reported a compliance of 56.1% and 30.5% to HH practices among healthcare workers in healthcare facilities with and without HH interventions, respectively.<sup>8</sup> Wieden mayer *et al.*, proved that whenever IPC trainings i.e., HH is offered among HCWs, there is always a room for improvement, definitely reducing the burden of HAIs.<sup>8</sup> We therefore hypothesised that, the level of HH knowledge, attitudes and practices among HCWs improved dramatically during the global COVID-19 pandemic. This is because, during the COVID-19 pandemic, HH was among employed strategies for preventing the spreading of the virus known to cause COVID-19. Therefore, this study determined the knowledge, attitude, and practices of hand hygiene among students and nurses in 6 healthcare facilities in Mwanza, Tanzania.

## METHODS

### Study Design, Duration, and Settings

This was a cross-sectional, hospital-based study conducted from August to October 2020 in primary, secondary, and tertiary healthcare settings in Mwanza, Tanzania. Primary healthcare facilities included 2 health centres; secondary healthcare facilities included 2 District Hospitals; and tertiary healthcare facilities included 1 Regional Referral Hospital and 1 Zonal Referral Hospital. The estimated number of nurses (employees) in each Health Centre was 20 and 14 in the 2 health centres; 125 and 87 in the 2 District Hospitals; 163 in Regional Referral Hospital, and 513 in Zonal Referral Hospital respectively. Student nurses pursuing bachelor's degree in Nursing practice their clinical subjects in tertiary healthcare facilities (Regional Referral and Zonal Referral Hospitals).

### Study Population, Sample Size Estimation and Selection Criteria

The population of this study comprised mainly nurses (staffs and students in clinical rotations) because it's the nurses that mostly provide medical care services (e.g., samples collection, giving injections and cleaning of wards/clinics) to patients both in wards and clinics. Therefore, they possess the major risk of transmitting pathogens between patients, and patients and contaminated hospital environment resulting to patients' acquisition of HAIs. The minimum sample size for this study was 384, obtained by using Kish Leslie formula (1965) and a prevalence of 50%. We used a prevalence of

of 50% to calculate the sample size because there was no similar study conducted in Tanzania before. All nurses (staffs and students in clinical rotation) in the selected healthcare facilities who were on practice and consented to participate in this study were enrolled. A total of 750 nurses were enrolled in the study but 24 were excluded due to incompleteness of their data collection tool. Therefore, only 726 participants were considered for final data analysis.

### Sampling Procedure and Data Collection

Simple random sampling method was used, whereas participants in the respective healthcare facilities under this study were enrolled consecutively until overall sample size was met. Due to unequal staffing levels of the selected study sites, the distribution of enrolled participants is not equal.

### Data Collection, Management, and Analysis

Self-administered pretested structured questionnaire was used for data collection. The questionnaire was sectioned into 4 parts namely; PART A: socio-demographic questions, PART B: comprised with 15 knowledge-based questions, PART C: comprised with 7 attitude based questions, and PART D: comprised with 10 practice-based questions. For knowledge based questions, scores were expressed in percentages and for each correct answer one point was awarded. To get percentages, points earned from correct answers by participant were divided by total points the participant was supposed to earn and then multiplied by 100%. Thus, the level of knowledge on HH among participants was categorised into good knowledge (>75%), moderate knowledge (50%-74%) and poor knowledge (<50%) as reported in previous studies.<sup>9</sup>

All data were transferred to Microsoft excel spreadsheet for cleaning and coding and then to STATA software version 13.0 for analysis. Percentages and fractions were used to present categorical data while median (interquartile range: IQR) were used to present continuous data. Chi square and logistic regression analysis were simultaneously performed to determine the association between categorical outcome i.e., knowledge level on HH and categorical predictors i.e., socio-demographic data. To facilitate analysis of association between categorical outcome and categorical predictors, 2 levels of knowledge (poor and moderate) were categorised to "not knowledgeable" while good knowledge was categorised to "knowledgeable". A p-value of less than .05 at 95% Confidence Interval (CI) was considered statistically significant.

### Ethical Considerations

This study was approved by the joint CUHAS/BMC Research Ethics and Review Committee (CREC) with certificate number: 1590/2020. Permission to conduct this study was sought for from the administrations of the respective healthcare facilities. All participants were requested to sign informed written consent forms before being enrolled into the study. To ensure that confidentiality is observed throughout the study, unique identification codes were used to identify participants as opposed to use of participants' names. During data collection, physical distancing, wearing of face masks and use of alcohol-based sanitisers were observed to prevent

the possible spreading of COVID-19.

## RESULTS

### Socio-Demographic Characteristics of Study Participants

A total of 726 nurses aged between 18 to 59 years with median [IQR] age of 29[24-38] years were enrolled to the study. The majority of participants were females (60.6%; n=440), working in the inpatient departments (83.5%; n=606), enrolled from tertiary healthcare settings (81.7%; n=593), and staff nurses (56.2%; n=408) with working experience of more than 5 years (75.2%; 307/408).(Table 1).

### Levels of knowledge on HH among Nurses

More than 3 quarters (76.4%; 555/726) of the study participants had good knowledge on HH and had received training on HH(88.3%; 641/726) during the COVID-19 pandemic from March to May 2020 prior to the study. Two thirds (68.5%;497/726) of the participants reported patient exposure to colonised surface and another two thirds (66.7%; 484/726) of respondents reported germs already present on patient body as the main route of cross-transmission and infections. The majority of participants acknowledged that, HH actions prevent transmission of germs to patients if well practiced: before touching the patient (96.1%; n=698); immediately after a risk of body fluid exposure (91.2%; n=662); after exposure to immediate surroundings of a patient (87.2%; n=638); and immediately before a clean/aseptic procedure (90.4%; n=656). The majority of respondents reported that HH protects HCW from pathogens when it is practiced: after touching a patient (93.8%; n=681); immediately after a risk of bodily fluid exposure (92.1%; n=668); immediately after a clean/aseptic procedure (100%; n=726); and after exposure to the immediate surroundings of a patient (89.7%; n=651). Most of the participants (79.9%; n=580) admitted that, if you touch the patient's environment you have essentially touched the patient.

On the other hand, only a quarter (25.3%; 184/726) and nearly two quarters (60.1%; 436/726) of nurses correctly answered the minimal time needed for alcohol-based hand rub (20-30 seconds) and for hand washing with water and soap (40-60 seconds), respectively. However majority (87.7%; 637/726) of the participants reported that, hand washing should be done using water and soap. Most of the nurses agreed that, wearing jewellery (91.1%; n=661), damaged skin (100%, n=726), artificial finger nails (92.2%; n=669) and regular use of hand creams (82.8%; n=601) should be avoided as they increase the likelihood of becoming colonised with harmful germs. Majority of the nurses also admitted that watches/bracelets (93.5%; n=679) and rings (91.5%; n=664) should be removed; wrist (95.3%; n=692) should be washed; and all cuts/lacerations (83.2%; n=604) should be covered with waterproof dressing during hand washing, and that hands (96.6%; n=701) need to be dried after hand washing(Table 2).

### The Attitudes of Nurses (Staffs and Students in Clinical Practices) towards Hand Hygiene

More than one-third (42.0%; n=305) of the participants said it requires no effort to practice good HH while more than a quarter (29.2%; n=212) said it requires big efforts

to practice good HH. More than half (56.6% 411/726) of the participants said that they require no reminders so as to practice HH. The rest (43.4%; 315/726) who requires a reminder, the majority of them (63.5%; 200/315) said the availability of posters is enough to remind them to practice good HH. On the other hand, more than half of the nurses believed that; hand rubbing is more rapid for hand cleansing than hand washing (53.4%; n=388), hand rubbing causes skin dryness more than hand washing (50.3%; n=365), hand washing is more effective against germs than hand rubbing (54.4%; n=395), and that hand washing and hand rubbing should not be performed in sequence (53.2%; n=386). Furthermore, more than half (53.2%; 386/726) and nearly three quarters (74.2%; 539/726) of the respondents reported that, the use of gloves damages the skin and that the purpose of HH is to prevent transmission of infections from patients to HCWs, respectively (Table 3).

**TABLE 1: Socio-Demographic Characteristics of Study Participants**

Variables	Frequency (n)/ median (IQR)	Percentages (%)
Median age [IQR] in years	29 [24-38]	N/A
Gender		
Females	440	60.6
Males	286	39.4
Status		
Student nurses	318	43.8
Staff nurses	408	56.2
Facility		
Primary healthcare	32	4.4
Secondary healthcare	101	13.9
Tertiary healthcare	593	81.7
Education level		
Certificate	128	17.6
Diploma	353	48.6
Degree and above	245	33.8
Profession		
Nurse	103	14.1
Midwife	10	1.4
Nurse and midwife	274	37.7
Intern nurse	20	2.8
Student nurse	318	43.8
Department		
Outpatient departments	120	16.5
Inpatient departments	606	83.5
Working experience of staff nurses		
<5 years	101	24.8
>5 years	307	75.2

### The Practices of Nurses (Staffs and Students in Clinical Practices) on Hand Hygiene.

More than three quarters (81.1%; 589/726) of the respondents routinely practiced hand washing than hand rubbing. Further, majority of the respondents (97.5%;-

**TABLE 2: The Level of Knowledge on HH Among Study Staff Nurses and Student Nurses in Clinical Practices**

Question	Response	Frequency (n)	Percentage (%)
Did you receive formal training in HH in the last three years?	Yes	641	88.3
	No	85	11.7
Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care facility?	Health-care workers hands when not clean	159	21.9
	Air circulating in the hospital.	30	4.1
	Patients exposure to colonised surfaces (i.e. beds, chairs, tables, floors)	497	68.5
	Sharing non-invasive objects (i.e. stethoscope, pressure cuffs etc.) between patients.	40	5.5
What is the most frequent source of germs responsible for health care-associated infections?	The hospitals water system	48	6.6
	The hospital air	33	4.6
	Germs already present on or within the patient	484	66.7
	The hospital environment(surfaces)	161	22.2
Which of the following HH actions prevents transmission of germs to the patients? Before touching the patient	Yes	698	96.1
	No	28	3.9
	Immediately after a risk of body - fluid exposure	662	91.2
	No	64	8.8
	After exposure to the immediate-surroundings of a patient	638	87.9
	No	88	12.1
Immediately before a clean/aseptic-procedure	Yes	656	90.4
	No	70	9.6
Which of the following HH actions prevents transmission of germs to the health-care worker? After touching a patient	Yes	681	93.8
	No	45	6.2
	Immediately after a risk of bodily-fluid exposure.	668	92.1
	No	58	7.9
	Immediately before a clean/aseptic-procedure	726	100.0
	No	-	-
	After exposure to the immediate-surroundings of a patient	651	89.7
	No	75	10.3
If you touch the patient's environment you have essentially touched the patient	True	580	79.9
	False	146	20.1
What is the minimal time needed for alcohol-based hand rub to kill germs on your hands?	20 seconds	184	25.3
	3 seconds	156	21.5
	60 seconds	206	28.4
	10 seconds	180	24.8
What is the correct duration for hand washing with water and soap?	20-30 seconds	245	33.8
	40-60 seconds	436	60.1
	90 seconds	16	2.2
	120 seconds	29	3.9

*Continued*

**TABLE 2: Continued**

Question	Response	Frequency (n)	Percentage (%)	
With what you wash your hands?	Only water	14	1.9	
	Water with soap	637	87.7	
	Water with ash	71	9.8	
	Others	4	0.1	
Which of the following should be avoided, as associated with increased likelihood of colonization of hands with harmful germs?	Wearing jewellery	Yes	661	91.1
		No	65	8.9
	Damaged skin	Yes	726	100
		No	-	-
	Artificial finger nails	Yes	669	92.2
		No	57	7.85
	Regular use of a hand cream	Yes	601	82.8
		No	125	17.2
	Watch and bracelet should be removed during hand washing?	Yes	679	93.5
		No	47	6.5
Rings should be removed during hand washing?	Yes	664	91.5	
	No	62	8.5	
Wrist should be washed during hand washing?	Yes	692	95.3	
	No	34	4.7	
Hands need to be dried after washing?	Yes	701	96.6	
	No	25	3.4	
All cuts and lacerations shall be covered with a waterproof dressing.	True	604	83.2	
	False	122	16.8	
Level of knowledge on HH	Poor (scored <50%)	0	0	
	Moderate (scored 50-74%)	171	23.6	
	Good (scored >75%)	555	76.4	

708/726) changed gloves when serially contacting different patients, of whom (91.5%; 664/726) practiced HH before putting on gloves to attend to the next patient. Moreover, almost all respondents (98.7%; 716/726) practiced HH after removal of gloves, however they believe gloves protects them from contamination. In the following situations: -before palpation of the abdomen, more than 3 quarters of nurses preferred hands rubbing (78.1%; 567/726); before giving an injection, more than half of the respondents preferred hands washing (52.6%; 382/736); after emptying a bedpan, more than 3quarters of respondents preferred hands washing (88.8% 645/726); after making patients' bed, more than half of the respondents preferred hands washing (58.9%; 428/726); and after visible exposure to blood, more than 3quarters of respondents preferred hands washing (81.3%; 590/726). About 94.5% (686/726) of the respondents reported that HH facilities are always available at their duty stations, while majority 90.7% (658/726) reported that hands washing facilities are always available compared to alcohol-based hand

rub facilities. However, only 61.2% (444/726) of the respondents practiced hand washing correctly in terms of the minimum time (40-60 seconds) one should take while washing their hands while only a quarter 26.6% (193/726) practiced hand rubbing for correct minimal time (20-30 seconds). Lastly, about 93.8% (681/726) declared that, adherence to hands hygiene standards are discussed during staff orientations and handovers (Table 4).

**Factors Associated with Knowledge level on Hand Hygiene among Staff and Student Nurses in Clinical Practices.**

Being a nurse student [OR: 0.30, 95%CI: 0.21-1.44, *p*<.001], working in an inpatient department [OR: 0.38, 95%CI: 0.27-0.55, *p*<.001], with a degree in formal education or above [OR: 1.74, 95%CI: 1.36-2.24, *p*<.001] and being a staff nurse with working experience of >5 years [OR: 2.41, 95%CI: 1.52-3.82, *p*<.001] was associated with being knowledgeable on HH among nurses (Table 5).

**TABLE 3: The Attitudes of Nurses (Staffs and Students in Clinical Practices) Towards Hand Hygiene**

Question	Response	Frequency (n)	Percentage (%)	
What effort is required for you to perform good HH?	0 (No effort)	305	42.0	
	1	151	20.8	
	2	27	3.7	
	3	31	4.3	
	4 (A big effort)	212	29.2	
Do you need reminder to perform HH practice at various point of care?	No	411	56.6	
	Yes	315	43.4	
If yes (from the above question), who/ what do you want to remind you to perform HH?	Posters	200	63.5	
	In-charge/Matron	32	10.2	
	Demonstration	83	26.3	
Which of the following statements on alcohol-based hand rub and hand washing with soap and water are true?	Hand rubbing is more rapid for hand cleansing than hand washing	False	338	46.7
	Hand rubbing causes skin dryness more than hand washing	True	388	53.4
	Hand rubbing is more effective against germs than hand washing	True	365	50.3
	Hand washing and hand rubbing are recommended to be performed in sequence	False	361	49.7
		True	331	45.6
		False	395	54.4
		True	340	46.8
Does the use of gloves damage your skin?	Yes	386	53.2	
	No	340	46.8	
What is the reason for you to practice HH?	To prevent contact of COVID-19	45	6.2	
	To prevent transmissions of infections from patients to you	539	74.2	
	To prevent transmissions of infections from you to patient	142	19.6	

**DISCUSSION**

This is the first study on HH knowledge level, attitude and practices among nurse (staffs and students in clinical practices) during the global COVID-19 pandemic in this region. This study found out that majority of the participants were female nurses with working experience of more than 5 years, working in inpatient departments and enrolled from tertiary healthcare settings. These findings are similar to studies conducted in Tanzania<sup>8</sup> and Nigeria,<sup>6</sup> before the global COVID-19 pandemic. Majority of the participants were females because of the nature of the profession (nursing) being preferred mostly by females. Majority of the participants were staff nurses because few students are enrolled to pursue Bachelor of Nursing in the few Medical Universities available in the country and only senior students were eligible for clinical rotations. Furthermore, majority of the nurses were working in inpatient departments, this may be because the department requires significantly a higher number of work force (HCWs) to take care of hospitalised patients. As student nurses were excluded from working experience, majority of staff nurses had experience of more than 5 years. Lastly, majority of the nurses were

enrolled from tertiary healthcare facilities because of the large bed capacities of these hospitals coupled with large number of patients attended to per day compared to lower tier (primary and secondary) healthcare facilities. For example, a Regional referral hospital has about 350 bed capacity while Zonal Referral hospital has over 950 beds capacity (<https://www.bugandomedicalcentre.go.tz/index.php?bmc=1>). Also, student nurses practice their respective clinical subjects in these tertiary healthcare settings and this also increased the number of participants enrolled from the tertiary healthcare facilities.

Three quarters of nurses enrolled in this study had good level of knowledge on HH contrarily to a study by Wieden mayer *et al*, which was conducted before the global COVID-19 pandemic in the same region in Tanzania<sup>8</sup>. The higher level of knowledge on HH among nurses in this study can be attributed to the fact that, nearly 9 out of 10 nurses enrolled in this study received formal training on IPC during the global COVID-19 pandemic from March to May 2020. The IPC training package received by HCWs included but not limited to hand hygiene, contact precaution and use of Personal Protective Equipments (PPEs). It was evidenced in a study by Wieden mayer

**TABLE 4: The practices of nurses (staffs and students in clinical practices) on Hand Hygiene**

Question	Response	Frequency (n)	Percentage (%)
Do you routinely use an alcohol-based hand rub or hand washing with soap and water?	Hand rub	137	18.9
	Hand washing	589	81.1
Do you change gloves when contacting different patients?	Yes	708	97.5
	No	18	2.5
If yes (from the above question), do you practice HH before putting on gloves for the next patient?	Yes	664	91.5
	No	62	8.5
Since gloves can prevent the contamination of the hands, do you always perform hands hygiene after taking off the gloves?	Yes	716	98.7
	No	10	1.3
Which type of HH method you may practice in the following situations?			
Before palpation of the abdomen	Rubbing	567	78.1
	Washing	140	19.3
	None	19	2.6
Before giving an injection	Rubbing	334	46.0
	Washing	382	52.6
	None	10	1.4
After emptying a bedpan	Rubbing	71	9.8
	Washing	645	88.8
	None	10	1.4
After making a patients bed	Rubbing	286	39.4
	Washing	428	58.9
	None	12	1.7
After visible exposure to blood	Rubbing	127	17.5
	Washing	590	81.3
	None	9	1.2
Are the HH facilities always available?	Yes	686	94.5
	No	40	5.5
If yes (from the above question), what facilities are always available?	Alcoholic hand rub	51	7.0
	Water and soap	658	90.7
	Water only	17	2.3
How much minimal time do you use to rub/sanitise your hands with alcohol-based hand rub?			
	20 seconds	193	26.6
	3 seconds	177	24.4
	60 seconds	161	22.2
	10 seconds	195	26.9
How much minimal time do you use for hand washing with water and soap?			
	20-30 seconds	253	34.9
	40-60 seconds	444	61.2
	90 seconds	11	1.5
	120 seconds	18	2.5
Is the adherence to HH standards discussed during staff handovers?			
	Yes	681	93.8
	No	45	6.2

*et al.*,<sup>8</sup> that provision of training on IPC i.e., HH among HCWs is proportion to their improved knowledge, practices and attitude. Therefore, IPC trainings i.e., may bring positive impact in minimising the emergence and spreading of HAIs as reported previously in a study

conducted in Taiwan.<sup>10</sup> The good level of knowledge on HH among nurses in this study was evidenced through the results from a basic knowledge-based questionnaire administered to the participants. The questionnaire included questions such as; types of HH actions which

**TABLE 5: Factors Associated with Knowledge level on HH among Staff and Student Nurses in Clinical Practices**

Variable	Knowledge level		Chi-square analysis		Logistic regression analysis	
	Not know-ledgeable	Know-ledgeable	X2	p-value	OR[95%CI]	p-value
Gender						
Male	66 (23.1)	220 (76.9)				
Female	105 (23.9)	335 (76.1)				
			0.0569	0.807	0.96[0.67-1.36]	.807
Student nurses vs staff nurses						
Student nurse	40 (12.6)	278 (87.4)				
Staff nurse	131 (32.1)	277 (67.9)				
			37.8534	0.000	0.30[0.21-1.44]	.000
Level of education						
Certificate	44 (34.4)	84 (65.3)				
Diploma	91 (25.8)	262 (74.2)				
Degree and above	36 (14.7)	209 (85.3)				
			19.9760	0.000	1.74[1.36-2.24]	.000
Working experience of staff nurses						
<Five years	49 (48.5)	52 (51.5)				
>Five years	83 (27.0)	224 (73.0)				
			14.4214	0.000	2.41[1.52-3.82]	.000
Facility						
Primary (Level 2)	5 (15.6)	27 (84.4)				
Secondary (Level 3)	27 (26.7)	74 (73.3)				
Tertiary (Level 4 & 5)	139 (23.4)	454 (76.5)				
			1.6883	0.430	0.95[0.67-1.32]	.751
Department						
Inpatient	112 (18.5)	494 (81.5)				
Outpatient	45 (37.5)	75 (62.5)				
			28.2941	0.000	0.38[0.27-0.55]	0.000

prevents the transmission of germs causing HAIs between patients, patients and HCWs; removal of watches, bracelets, and rings during hand cleaning; and covering of all cuts and lacerations on HCWs' hands. Majority (>80%) of nurses got these knowledge-based questions correct. However, the minority who received no formal training on IPC measures; basically on HH (about 11%) and those who got wrong the knowledge-based questions in the administered questionnaire (~20%) should not be ignored. Thus, strategic trainings and retraining following assessments to determine improved level of knowledge on IPC measures, mainly HH is recommended at all levels of healthcare tiers in this region. Since they are not correctly knowledgeable, basically they maybe incorrectly practicing HH, hence, their hands may potentially act as vehicles in cross-transmission of harmful germs between patients, and patients and their immediate environments resulting to the emergence and spread of HAIs including MDR pathogens.

Nearly, half of the nurses enrolled in this study considers HH as an effortless action however the rest considered

this action as laborious. The attitude of nurses to HH as a laborious action, may negatively affect effectiveness of HH compliance. A study by Engdaw *et al.*, found that, positive attitude towards HH increases the likelihood of HH compliances.<sup>10</sup> Furthermore, at least one in two nurses believed that the presence of reminders viz., posters at their work stations will make them recall good HH practices. Multimodal interventional studies by Lam *et al.*,<sup>11</sup> and Alp *et al.*,<sup>12</sup> found that the use of reminders including posters increase compliance to HH among HCWs. In this study, more than half of the nurses believed hand rubbing using alcohol based agents is more rapid but it is not as effective as hand washing. Although, an experimental study by Ehrenkranz and colleague found that, alcohol-based hand rubbing is superior to hand washing in prevention of transfer of Gram-negative bacteria to catheters by the hands of HCWs.<sup>13</sup> However, WHO recommends hand washing whenever hands are visibly soiled with blood or other body fluids.<sup>4</sup> In this study, nurses believed that, hand rubbing causes skin dryness. This may happen when plain alcohol-based hand



rub is used. Therefore, the use of glycerol (humectant for skin care) supplemented alcohol-based hand rubs is recommended as reported by the WHO.<sup>14</sup> Moreover, more than half of nurses reported that, the use of gloves damage their skin. This happens when latex-examination powdered gloves are worn for a long duration, resulting into skin dryness and roughness. Also, hypersensitivity to natural rubber latex (NRL) have been reported.<sup>15, 16, 17</sup> The use of powder-free gloves (if possible) and the presence of petroleum jelly at all hand washing stations is recommended in cases of hypersensitivity to NRL or skin dryness and roughness, respectively.<sup>16, 17</sup> Lastly, about 3quarters of nurses think that HH aims at preventing transmission of infections from patients to HCWs. Therefore, they need to be updated on the risk of their hands acting as vehicles in cross-transmission of infectious agents (e.g., bacteria, fungi and viruses) between patients, and patients and their immediate environments as previous reported in “my five moments of HH” by the WHO.<sup>4</sup>

Majority of nurses in this study practiced hand washing than hand rubbing. A similar observation was reported elsewhere.<sup>18</sup> This may be because hand washing facilities are always readily available as reported by nurses in this study. However, participants’ attitude that hand washing is more effective against harmful germs than hand rubbing may also explain why the majority of nurses prefer hand washing. Moreover, most of the nurses change gloves in between when attending to different patients and before put on gloves for the next patient, nurses practice hand cleaning. Nurses in this study may be knowledgeable that long duration of gloves wearing facilitates re-colonisation of hands as reported by Grasso *et al.*,<sup>19</sup> and Wistrand *et al.*,<sup>20</sup>. Therefore, hand cleaning is recommended whenever gloves are removed. Further, during situations like palpation of the abdomen, giving an injection, emptying a bedpan, making of patient’s bed, and visible exposure to blood, most nurses prefer to practice hand washing over hand rubbing as recommended by WHO.<sup>21</sup> This may be because facilities for hand washing are always available or due to the participants’ attitude that hand washing is more effective than hand rubbing. Despite the fact that, the majority of nurses reported that HH standards are discussed during shift handovers, nearly a half and about one third of the participants practiced hand rubbing and hand washing in less than the recommended minimum time, respectively. Thus, frequent trainings and retraining on IPC measures i.e., HH are recommended to make sure the majority if not all nurses practice hand cleaning (rubbing and washing) correctly.

Finally, in this study we observed that, being a nurse student, working in the inpatient department, increased level of formal education i.e., degree and above, and being a staff nurse with working experience of >5 years was associated with being knowledgeable on HH among student and staff nurses. Similar observations were reported in previous studies.<sup>22, 23</sup> Student nurses had received training on IPC measures recently during their lectures as a part of strategy to prevent transmission of COVID-19 among University community and during clinical practices in wards or clinics. They were also more likely to adhere to clinical guidelines including HH as they are at all times under supervisions during their respective

clinical rotations. Nurses working in the inpatient departments may have evidenced critical cases and outcomes of infectious diseases such as COVID-19 than those from outpatient departments. From this phenomenon, their alertness to seeking for more information on IPC measures including HH may have increased and definitely increasing their level of knowledge. Increasing level of formal education among nurses is proportional to having sufficient knowledge on infectious diseases, therefore increasing the likelihood of seeking further knowledge of infection prevention and control i.e., HH.<sup>22</sup> Lastly, as reported by Asadollahi *et al.*,<sup>23</sup> our study also observed that working experience of 5 years and above is associated with increased level of HH knowledge among the nurses which may be explained as they have received more trainings on IPC measures notably HH.

## CONCLUSION

Majority of the nurses exhibited good level of knowledge about hand hygiene. This could have been enhanced through the extensive and frequent trainings on IPC notably HH during the global COVID-19 pandemic between March and May 2020.

We recommend that, HCWs are reminded on the correct duration required for effective HH because only two thirds and a third practiced hand washing and hand rubbing within recommended duration respectively. We also recommend further studies focusing on the compliance of HCWs on HH.

## Study Limitations

Recall bias among study participants maybe a limitation of this study.

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