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Research Paper

Hand hygiene compliance and its predictors among healthcare providers in primary healthcare settings in the Girawa District, Eastern Ethiopia

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ABSTRACT

Hands of healthcare workers are the most common vehicle for the transmission of healthcare-associated pathogens from patient to patient and within the healthcare environment. This study aimed to assess the level of hand hygiene compliance and its predictors among healthcare providers working in primary healthcare settings in the Girawa District, Eastern Ethiopia. A facility-based cross-sectional study was conducted from November 1 to December 1, 2023 among 398 randomly selected healthcare providers. Data summary statistics, bivariate, and multivariable logistic regression models were used. Adjusted odd ratio, 95% confidence interval (95% CI), and *p*-value of <0.05 was used to identify predictors of hand hygiene compliance among healthcare providers. In this study, the overall hand hygiene compliance was 30.15% [95% CI (25.68–34.92)]. Being trained about hand hygiene, having a BSc degree, availability of handwashing facility setup in working room, knowledge about hand hygiene and having good hand hygiene were significantly associated with hand hygiene compliance. Limited knowledge and lack of water, sanitation, and hygiene (WASH) facilitates have significant influences for health workers' hand hygiene compliance. Hence, the primary healthcare settings should be equipped with adequate supply to all the basic hand hygiene facilities and build staff capacity in WASH through periodic training.

Key words: compliance, Ethiopia, hand hygiene, health workers, primary healthcare facilities

HIGHLIGHTS

- Water, sanitation, and hygiene (WASH) plays an important role in enabling healthcare staff to follow necessary Infection Prevention and Control (IPC) measures.
- To prevent spreading of infections among both healthcare staff and patients. Thus, they must have access to necessary materials to improve their hygiene behaviors.

INTRODUCTION

Hands and clothes of healthcare workers (HCWs) are the most common vehicle for the transmission of healthcare-associated pathogens from patient to patient and within the healthcare environment. Healthcare-associated infections (HCAIs), also referred to as 'nosocomial' or 'hospital' infections, are infections that patients acquire while receiving treatment for medical or surgical conditions and are the most frequent adverse event during care delivery. HCAI is a major problem for patient safety, and its impact can result in prolonged hospital stays, long-term disability, increased resistance of microorganisms to antimicrobial agents, a massive additional financial burden for the health system, high costs for patients and their families, and excess deaths (WHO 2011). Hand hygiene is a frequently missed lifesaving opportunity during patient care (Trampuz & Widmer 2004). World Health Organization (WHO) has estimated that hundreds of millions of patients are affected by HCAIs leading to deaths in one among 10 infected patients every year (WHO 2020). Globally, out of every 100 patients in acute-care hospitals, seven patients in high-income countries (HICs) and 15 patients in low- and middle-income countries

(LMICs) acquired at least one HCAI during their stay (WHO 2022). Thus, hand hygiene is vital in reducing HCAIs and preventing the spread of antimicrobial resistance.

In response to these challenges, assessing water, sanitation, and hygiene (WASH)-related risks and WASH measures is pivotal to mitigating the spread of infectious diseases and ensuring a safe environment for patients, visitors, family members, and health and care workers. However, HCW hand hygiene compliance with optimal practices remains low in most settings, particularly in developing countries (Allegranzi & Pittet 2009; Haque *et al.* 2020). Furthermore, inadequate Infection Prevention and Control (IPC) practices were reported among HCWs, sanitary workers, and even in IPC experts (Sahiledengle *et al.* 2018; Tolera *et al.* 2024).

Hand hygiene is a general term referring to any action of hand cleaning that is related to the removal of visible soil, and the removal or killing of transient microorganisms from the hands while maintaining good skin integrity resulting from a hand care program (WHO 2009). According to the WHO guidelines, handwashing remains the most effective measure to prevent the mode of transmission of microorganisms (WHO 2009). The WHO has recommended five times for the hand hygiene approach, to effectively interrupt the spread of HCAIs (Sax *et al.* 2007). This approach encourages HCWs to clean their hands before patient contact, before an aseptic procedure, after body fluid exposure, after patient contact, and after contact with patient's surroundings (WHO 2009). However, the hand hygiene compliance rate in sub-Saharan Africa is estimated to be 21.1% (Ataiyero *et al.* 2019).

Despite being vital for safe health delivery, hand hygiene practices at the point of care remain suboptimal worldwide (World Health Organization 2023). Significant disparities between high- and lower-income countries exist. Clearly, a better understanding of factors influencing hand hygiene behavior is needed, as is prioritization of research areas where gaps still exist. The studies conducted among health workers in hospitals in Northern and Eastern Ethiopia found 68 and 35% overall compliance of hand hygiene, respectively (Umar *et al.* 2022; World Health Organization 2023; Daba *et al.* 2024).

In LMICs like Ethiopia, the primary healthcare institutions are relatively accessible, require low cost, and the majority of patients primarily visit when they get sick (World Health & United Nations Children Fund 2018). Additionally, various studies conducted in handwashing compliance among health workers focused on hospitals, or they are inconsistent in covering important indicators such as handwashing critical time (Awoke *et al.* 2018), with limitations in including all potential predictors and healthcare professionals (Desta *et al.* 2018). Furthermore, most studies relied on a self-reported questionnaire that could be subjected to an overestimation of hand hygiene compliance (Abdo *et al.* 2020; Tadesse *et al.* 2022). As a result, a structured questionnaire-based study embedded with an observation-based assessment of the existing WASH facilities as proxy indicators for hand hygiene practice can help to determine the extent to which professionals reported and observed practices differ. Therefore, this study planned and assessed the level of hand hygiene compliance and its predictors among healthcare providers in primary healthcare facilities in the Girawa District, Eastern Ethiopia, using a structured pretested questionnaire and observational checklist.

METHOD AND MATERIALS

Study area

The study was conducted in primary healthcare facilities in the Girawa District with latitude: 8° 54′ 59.99″ N and longitude: 41° 39′ 59.99″ E, Eastern Ethiopia. Its' borders are Gola Oda Meyu Mulike District in the south, Bedeno in the west, Kurfa Challe District in the north, and Fedis in the east. The administrative center of the District is Girawa town. The District is located 575 km away from the capital city of Addis Ababa and 75 km away from Harar. The total population is estimated to be 365,359 in the District and 340,631 in the rural areas. Regarding the health sector, the district has one primary hospital, nine health centers, 47 health posts, two private clinics, and three pharmacies.

Study design and period

A facility-based cross-sectional study was conducted from November 1 to December 1, 2023.

Populations

All healthcare providers working in the governmental health facilities in the Girawa District were source population. The study population was all healthcare providers (medical staff, nurses, nurses' assistants, midwives, laboratory personnel, dentists, pediatricians, physiotherapists, and anesthetists) in the selected public health facilities in the Girawa District available during the study period. All healthcare providers who were recruited and available during the study period, and willing to

participate, were included in the study. Healthcare providers who had no active contact with patients and were not available during the data collection period were excluded from the study.

Sample size determination and sampling procedure

The sample size was calculated by a single population proportion formula by considering the proportion of hand hygiene compliance, 38% (Soboksa *et al.* 2021), 95% confidence interval (CI), and margin of error (5%), and the calculated sample size was 362. By considering a 10% non-response rate, the final minimum sample size became 400. A single proportion formula used to determine the sample size for this study was $n = (Z^2 \times pq)/d^2$. Here, n is the minimum sample size required for the study, Z with a confidence interval of 95% ($Z = 1.96$), p indicates a 38% of prevalence of hand hygiene compliance from a similar study, $q = 1 - p$, and $d =$ is a tolerable margin of error ($d = 0.05$).

Initially, the primary healthcare settings in the Girawa District were classified into a primary hospital, health centers, and health post clusters. By using simple random sampling techniques, out of 55 total public healthcare facilities, one hospital (namely Garamuleta Hospital), six health centers (namely, Lafto Health Center, Girawa Health Center, Dogu Health Center, Melba Health Center, Magala Arba Health Center, and Oromittu Health Center), and 26 health posts (namely, Lafto Harawa, Burka Gudina, Burka Jannata, Oda Jannata, Badu, Dursitu, Chiracha 03, Tokkuma Hire, Madda Jalala, Meyra Gudina, Lafto Somale, Dire Gamachu, Mojo Sade, Lenca, Birbirsa, Hula Janata, Mojo Tasmo, Mojo Baladi, Culul, R/jannata, Elaxaxeysa, Melba, Goro Jalala, Jiru Gamachu, Kurfa Biyyo, and Ejeresa Tobota Health Post) were randomly selected. Study participants were proportionally allocated between selected healthcare settings. Study participants were selected by using simple random sampling from selected primary healthcare settings (Figure 1).

Data collection methods

Data were collected by three trained BSc nursing professionals and three BSc environmental health workers, and supervised by three senior professionals. Data were collected using the tools adapted from WHO WASH guidelines (WHO 2016). The structured self-administered questionnaire containing four sections was used. Part I was about socio-demographic characteristics of the HCWs. Part II includes questions that were relevant to assessing institutional factors that influence the practice of hand hygiene. Part III contains hygiene behaviors related to knowledge, attitude, and training questions for health workers that were adapted from WHO (WHO 2016). Part IV contains self-administered questions with regard to their hand hygiene practices or compliance.

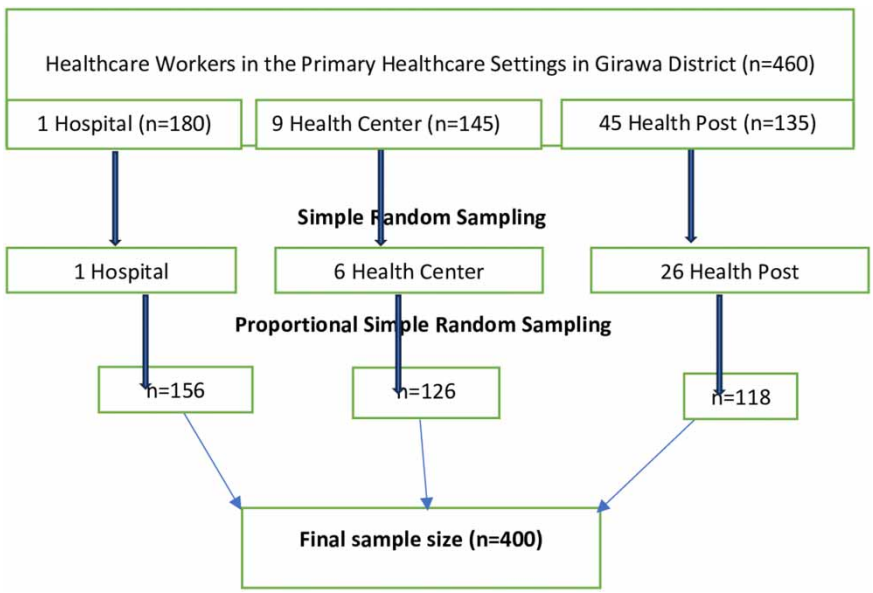

Figure 1 | Schematic representation that shows the sampling procedure to assess the level of hand hygiene compliance and its predictors among healthcare providers working in primary healthcare settings in the Girawa District, Eastern Ethiopia from November 1 to December 1, 2023.

The questionnaires were administered to healthcare professionals after the purpose of the study was explained, and informed consent was obtained from each participant, and the questionnaire had no personal identification to keep their confidentiality. Participants who were not interested in participating in the study have the right to quit the study. They could also ask any question at any time during the study. The questionnaire was administered to the study participant in a private place. Finally, filled questionnaires were collected by data collectors immediately.

Measurements

The dependent variable was hand hygiene compliance, and the independent variables were socio-demographic factors: age, sex, religion, marital status, work experience, educational level, institutional factors: availability of soap and water, availability of alcohol-based hand rub (ABHR), availability of handwashing setup, presence of IPC manual and unit of work, work shift, WASH policy and programs, and behavioral factor: knowledge, attitude, working hours, workload, training, busyness, forgetfulness, skin irritation by ABHR, hand hygiene.

Operational definition

Favorable attitude refers to a HCW who scored the mean and above the mean value of the hand hygiene attitude score (Gebresilassie *et al.* 2024).

Good hand hygiene compliance: healthcare providers who reported that they practiced all of the hand hygiene moments according to the WHO checklist (WHO 2016).

Good knowledge refers to a HCW who scored the mean and above the mean value of the knowledge question value (Gebresilassie *et al.* 2024).

Poor hand hygiene compliance: a healthcare provider who reported that they did not practise at least one of the hand hygiene moments on the WHO checklist (WHO 2016).

Data processing and analysis

Before analysis, data were collected, edited, and coded. Any error identified at this time was corrected after a review of the original data using the code numbers. After this, data were entered using Epi-Data version 3.1, and were analyzed using STATA 17 statistical software. Descriptive statistical analysis such as simple frequencies, measures of central tendency, and measures of dispersion was used to describe the characteristics of participants. The result was presented using frequencies, summary measures, tables, and figures. Bivariate and multivariate logistic regression models were used to identify predictors of hand hygiene practice. Finally, variables with p-value ≤ 0.25 in the bivariate analysis were taken into the multivariable model to control all possible confounders. Hosmer Lemeshow was done to test for model fitness. Multi-collinearity is checked to see the linear correlation among the independent variables by using a variance inflation factor and standard error. Variables with variance inflation factor >10 and a standard error >2 were dropped from the multivariable analysis. Odds ratios with a 95% CI were estimated to identify predictors' handwashing practices using multivariable logistic regression analysis. The level of statistical significance was declared at p-value ≤ 0.05.

Data quality control

Self-administered questionnaire checklists were prepared in English. Prior to actual data collection, a 2-day training was given to data collectors and supervisors on the data collection tool, data collection procedure, aim of the study, and confidentiality of the collected data from respective HWs. A pre-test on a self-administered questionnaire was conducted on 5% of final study subjects in non-selected facilities to ensure its validity, reliability and to check the wording of the questionnaires. The completeness of each questionnaire was checked by supervisors on a daily basis and finally it was confirmed by the principal investigator. Double data entry was done by two data clerks, and consistency of the entered data was cross-checked by comparing the two separately entered data.

Ethical considerations

Before starting the data collection process, the study protocol was approved by the Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) (Ref. No.: IHRERC/194/2023). Official letters of cooperation were written by Haramaya University College of Health and Medical Sciences to the Girawa District Office to obtain their cooperation in facilitating the study. 'Informed, voluntary, written, and signed consent' was obtained from all study participants after a clear description of the objectives, procedures, potential risks, and benefits of

the study by the data collectors before proceeding with data collection. The study participants were informed of their right to refuse or withdraw from the study at any time. Privacy and confidentiality of participants were maintained by excluding names and identifiers in the questionnaire. Informed, voluntary, written, and signed consent was obtained from all respondents throughout the study.

RESULTS

Socio-demographic characteristics

A total of 398 healthcare providers participated in the study with a response rate of 99.5%. The majority of the respondents, 256 (64.32%) were in the age group of 25–34 years, with a mean age of 29.73 (± 5.26 SD) years. More than half (56.03%) of the participants were male. With regard to their work experience, 205 (51.51%) of them had ≤5 years of experience, and 128 (32.16%) were working in the hospital (Table 1).

Organizational factors

More than half, 218 (54.77%), of the respondents took in-service WASH training. Around 250 (63.81%) of the respondents reported that their health facility or healthcare unit did not have handwashing facility setup, and 221(55.53%) of respondents did not obtain water for their handwashing in their facility (Table 2).

Attitude of respondents toward hand hygiene

The majority, 249 (71.84%), of respondents scored more on attitude showing they had a positive attitude toward hand hygiene (Table 3).

Table 1 | Socio-demographic characteristics of healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia, 2024 ($n = 398$)

Variables	Category	Frequency	Percent
Type of institutions	Hospital	128	32.16
	Health center	118	29.65
	Health post	152	38.19
Sex	Male	223	56.03
	Female	175	43.97
Age in years	18–24	67	16.83
	25–34	256	64.32
	≥35	75	18.84
Educational level	Diploma	302	75.88
	BSc	86	21.61
	MSc/specialty	10	2.51
Type of profession	Medical doctor	14	3.52
	Nurse	137	34.42
	Health officer	19	4.77
	Midwife	31	7.79
	Medical Laboratory Sciences	17	4.27
	Pharmacy	27	6.78
	Health extension	151	37.94
	Anesthesia	2	
Year of experience	<5	205	51.51
	6–10	131	32.91
	11–15	62	15.58
Marital status	Single	130	32.66
	Married	248	62.31
	Divorced	20	5.03
Religion	Christian	313	78.64
	Muslim	85	21.36

Table 2 | Organizational factors of healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia, 2024 ($n = 398$)

Variables	Category	Frequency	Percent
Formal in-service training related to hand hygiene in the last 3 years	Yes	180	45.23
	No	218	54.77
Absence of handwashing setup at working room	Yes	250	62.81
	No	148	37.19
Water availability in working room/unit	Yes	177	44.47
	No	221	55.53
Soap availability in working room	Yes	155	38.94
	No	243	61.06
Presence of running/piped water in working facilities	Yes	312	78.40
	No	86	21.61
Presence of towels in your handwashing setup/facility	Yes	145	36.43
	No	253	63.57
Presence of WHO WASH guideline in the organization	Yes	161	40.45
	No	237	59.55
Presence of toilet near to working area in the organization	Yes	164	41.21
	No	234	58.79
Does the toilet have handwashing setup/facility	Yes	124	75.61
	No	40	24.39
Availability of IPC guideline in the organization	Yes	151	37.94
	No	247	62.06
Presence of IPC committee in the facility	Yes	146	36.68
	No	252	63.32

Table 3 | | Attitude of respondents toward hand hygiene of healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia ($n = 398$)

Questions	Strongly agree	Agree	Not decided	Disagree	Strongly disagree
Do you believe that your hands could likely be a vehicle for the transmission of HCAIs to patients?	167(41.96%)	216(54.27%)	9	6	0
Hand hygiene before contact with patient is necessary	170(42.71%)	210(52.76%)	13(3.27%)	3	2
Do you think that hand rubbing is more rapid for hand cleansing than handwashing?	136(34.17%)	226(56.78%)	19(4.77%)	11(2.76%)	6
Handwashing is more effective against germs than hand rubbing?	131(32.91%)	230(57.79%)	19(4.77%)	13(3.27%)	5
Hand rubbing causes less skin dryness than handwashing	108(27.14%)	237(59.55%)	33(8.29%)	11(2.76%)	9(2.26%)
Adherence to correct hand hygiene practice at all times is critical	120(30.15%)	228(59.29%)	35(8.79%)	7	8
Do emergency and other priority issues make difficult hand hygiene practice	106(26.63%)	232(58.29%)	35(8.79%)	15(3.77%)	10(2.51%)
You feel guilty if you omit hand hygiene during patient handling?	110(27.64%)	245(61.56%)	32(8.04%)	7	4
Sharing stethoscopes or pressure cuffs between patients is the most common route of cross-transmission of potentially harmful germs between patients in a healthcare facility	110(27.64%)	235(59.05%)	37(9.3%)	6	10(2.51%)
Do you believe you have sufficient knowledge about hand hygiene?	110(27.64%)	239(60.05%)	33(8.29%)	8	8
Do you believe that training on hand hygiene to each healthcare worker would improve hand hygiene in your institution	107(26.88%)	242(60.80%)	36(9.05%)	6	7

Knowledge of study participants about hand hygiene

Of the study participants, 207 (52.51%) were scored higher than a mean of the knowledge questions, which showed that they had good knowledge about hand hygiene (Table 4).

Magnitude of hand hygiene compliance

Overall, the hand hygiene compliance of HCWs was 30.15% [95% CI: 25.68–34.92]. One hundred and thirteen (28.39%) of the HCWs always washed their hands before direct contact with the patient, while 98 (24.62%) always washed their hands before performing invasive procedures. One hundred and eleven (27.89%) always washed their hands before giving injections, whereas only 108 (27.14%) always washed their hands after contact with blood, body fluids, wounds, catheter sites, or drainage sites (Table 5).

Hand hygiene compliance among health workers varied across different health institutions. Hand hygiene compliance among health workers working in the hospital was 44%, and that of those working in the health post was around 26% (Figure 2).

Factors associated with hand hygiene compliance

In the bivariate analysis, variables like age, sex, years of working experience, educational level, availability of handwashing setup, attitude toward hand hygiene, being trained on hand hygiene, and knowledge about hand hygiene have shown a significant association with hand hygiene compliance at a p-value of <0.25, and were considered as candidates for multivariable analysis.

In the multivariable logistic regression model, educational level, availability of handwashing setup, attitude toward hand hygiene, being trained on hand hygiene, and knowledge about hand hygiene were significantly associated with hand hygiene compliance at a p-value of <0.05. Health professionals who have taken training about hand hygiene were 2.21 times (adjusted odds ratio (AOR) = 2.21, 95% CI: 1.37–3.57) more likely to have good hand hygiene compliance compared to their counterparts. Health professionals who have a BSc degree were 1.81 times (AOR = 1.81, 95% CI: 1.05–3.10) more likely to have good hand hygiene compliance than those who had a diploma. Study participants who had a handwashing facility setup in the working room were 2.35 times (AOR = 2.35, 95% CI: 1.41–3.92) more likely to have good hand hygiene compliance as compared to those who had no handwashing facility setup in the working room.

Those who had good knowledge of hand hygiene were 1.75 times (AOR = 1.75, 95% CI: 1.09–2.82) more likely to have good handwashing compliance than those who were not knowledgeable for hand hygiene. Furthermore, health professionals who had a positive attitude toward hand hygiene were 3.39 times (AOR = 3.39, 95% CI: 2.01–5.77) more likely to have good hand hygiene compliance as compared to their counterparts (Table 6).

DISCUSSIONS

Adequate hand hygiene is the main defense against infections linked to healthcare settings and against the spread of microbes resistant to multiple drugs. Many patients in healthcare settings are affected by healthcare professionals' poor hand hygiene compliance and associated complications (WHO 2009). This study includes the major components of healthcare systems: one general hospital, six health centers, and 26 health posts. From the total healthcare professionals included in this study, 223 (56.03%) were male.

The majority, 76% (302), of the study participants had a diploma and 86 (21.61%) had a BSc degree. Nearly, 45% (180) received formal in-service training related to hand hygiene in the last three years. Of the 309 respondents, 250 (62.81%) reported that their health facility had no handwashing setup in the working room, which is by far inferior to findings of other similar studies elsewhere (Engdaw *et al.* 2019; Potgieter *et al.* 2021; Umar *et al.* 2022). This might result from the large proportion of lower level professionals with inadequate knowledge and minimal authorities' attention given to the service quality in primary healthcare institutions. The present study found that the overall hand hygiene compliance of healthcare providers working in public healthcare settings in the Girawa District was 30.15% [95% CI: 25.68–34.92]. This finding is consistent with a study conducted in eastern Ethiopia (34%) (Umar *et al.* 2022) and Turkey (31.9%) (Karaaslan *et al.* 2014). However, this finding is higher than a study conducted in Waghimira Zone (20.6%) (Alene *et al.* 2022), Addis Ababa (22.2%) (Tadesse *et al.* 2022), Hiwot Fana Specialized University Hospital (18.7%) (Awoke *et al.* 2018), Dessie referral hospital (17.6%) (Tesfaye *et al.* 2022). In addition, this finding is lower than a study conducted in Hararghe Zone (37.4%) (Umar *et al.* 2022), Addis Ababa (50.4%) (Abdo *et al.* 2020) and Rwanda (72%) (Ndatimana *et al.* 2022). This discrepancy

Table 4 | Knowledge and attitude of respondents toward hand hygiene of healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia ($n = 398$)

Questions	Correct answer	percent
What is the main/superior route of cross-transmission of potentially harmful germs between patients in a healthcare facility? **Answer:** HCWs' hands when not clean	234	58.79
What is the most frequent source of germs responsible for HCAIs? (*circle one answer only*) **Answer:** Germs already present on or within the patient	163	40.95
What are the main hand hygiene actions to prevent germs transmission to the patients		
Before touching the patients	175	43.97
After touching the patients	200	50.25
Immediately after the risk of body	196	49.25
Immediately before an aseptic procedure	205	51.51
After getting exposed to the immediate surroundings of the patients	184	46.23
What is the hand hygiene actions to prevent germs transmission to HCWs		
Before touching the patients	196	49.25
After touching the patients	241	60.55
Immediately after the risk of body	251	63.07
Immediately before an aseptic procedure	146	36.68
After getting exposed to the immediate surroundings of the patients	250	62.81
What are the five key moments recommended for handwashing?	241	60.55
What is the minimal time needed for ABHR to kill most germs on your hands? *(circle one answer only)* **Answer:** 20 seconds	218	54.77
Do you know that alcohol hand gel is effective only on visibly clean hands **Answer**: true	212	53.27
Is rubbing the hand is more rapid than handwashing **Answer: true**	216	54.27
Is hand rubbing leads to skin dryness than handwashing **Answer: false**	173	43.47
Hand rubbing is a more effective germ protection system than handwashing **Answer: true**	216	54.27
Hand rubbing and washing are to be performed in sequence **Answer: false**	170	42.71
In which of the following situation hand rubbing or handwashing is required or recommended		
Before touching or palpation of the abdomen (**R**)	178	44.72
Before giving an injection (**R**)	164	41.21
After procedure or catheter insertion (**R**)	234	58.79
After emptying a bed pan (**W**)	237	59.55
After removing examination gloves (**R**)	240	60.30
After visible exposure to blood (**W**)	239	60.05
Which of the following should be avoided by healthcare workers, as associated with increased likelihood of colonization of hands with harmful germs?		
Regular use of a hand cream (**no**)	162	40.7
Wearing jewelry (**yes**)	158	39.70
Damaged skin (**yes**)	1	
Artificial fingernails (**yes**)	3	

Table 5 | Hand hygiene compliance among healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia ($n = 398$)

Hand hygiene practice	Always 3	Usually 2	Sometimes 1	Never 0
How frequent you prepare your hand before patient handling (After removal of rings, bracelets, etc.)?	124 (31.16%)	172(43.22%)	102(25.63%)	
How frequent you use water and soap to wash your hands?	110(27.64%)	161(40.45%)	125(31.41%)	2
How frequent you wash your hands before direct contact with a patient?	113(28.39%)	167(41.96%)	117(29.4%)	1
How frequent you wash your hands between contacts with different patients?	122(30.65%)	147(41.21%)	129(32.41%)	
How frequent you wash your hands between moving from a contaminated to a clean body site of the same patient	113(28.39%)	134(33.67%)	151(37.94%)	
How frequent you wash your hands before performing invasive procedures	98(24.62%)	160(40.2%)	139(34.92%)	
How frequent you wash your hands before contact with catheter sites and wound drainage sites	98(24.62%)	158(39.7%)	141(35.43%)	1
How frequent you wash your hands before preparing, giving medication and feeding a patient	98(24.62%)	153(38.44%)	145(36.43%)	2
How frequent you wash your hands before injections or venipuncture	111(27.89%)	138(34.67%)	146(36.68%)	3
How frequent you wash your hands before handling of clean or sterile materials	103(25.88%)	143(35.93%)	147(36.93%)	5
How frequent you wash your hands after having direct contact with patients	103(25.88%)	136(34.17)	154(38.69%)	5
How frequent you wash your hands after any non-surgical invasive procedure	99(24.87%)	140(35.18%)	154(38.69%)	5
How frequent you wash your hands after contact with blood, body fluids, wounds, catheter sites or drainage sites	108(27.14)	130(32.66)	153(38.44%)	7
How frequent you wash your hands after contact with any object in patient's immediate area	103(25.88%)	132(33.17%)	156(39.2%)	7
How frequent you wash your hands if hands are visibly soiled with dirt, fluid, excretion or blood	111(27.89%)	125(31.41%)	155(38.94%)	7
How frequent you wash your hands after using computer keyboard	111(27.89%)	130(32.66%)	148(37.19%)	9
Handwashing after any contact with surfaces (table, wall, door handles)	106(26.63%)	129(32.41%)	154(38.69%)	9
How frequent you wash your hands after toilet use	113(28.39%)	127(31.91%)	151(37.94%)	7

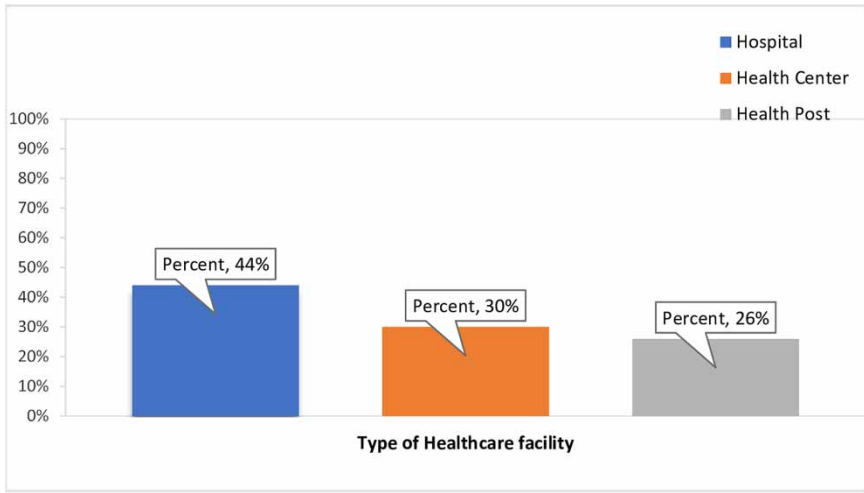

Figure 2 | Hand hygiene compliance among healthcare providers working in different public healthcare settings in the Girawa District, Eastern Ethiopia ($n = 398$).

Table 6 | Bivariable and multivariable analysis of factors associated with hand hygiene compliance among healthcare providers working in public healthcare settings in the Girawa District, Eastern Ethiopia, 2024

Variables	Category	Hand hygiene compliance		COR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
		Yes (%)	No (%)				
Educational level	MSc degree	8(50%)	8(50%)	2.84(1.03–7.84)	0.043	2.90(0.87–9.01)	0.084
	BSc degree	35(41%)	51(59%)	1.95(1.18–3.23)	0.009	1.81(1.05–3.10)	0.032[a]
	Diploma	77(26%)	219(74%)	1		1	
Sex	Female	41(23%)	134(77%)	0.56(0.36–0.87)	0.010	1.080(0.64–1.84)	0.758
	Male	79(35%)	144(65%)	1		1	
Type of institutions	Hospital	53(41%)	75(59%)	2.76(0.96–4.67)	0.346		
	Health center	36(31%)	82(69%)	1.71(0.98–2.98)	0.558		
	Health post	31(20%)	121(80%)	1			
Age in years	≥35	14(19%)	61(81%)	0.48(0.28–0.83)[a]	0.009	0.72(0.33–1.54)	0.397
	25–34	75(29%)	181(71%)	0.27(0.13–0.56)[a]	0.001	1.45(0.79–2.67)	0.236
	18–24	31(46%)	36(54%)	1			
Duration of experience in years	11–15	12(19%)	50(81%)	0.42(0.26–0.71)[a]	0.001	0.57(0.24–1.36)	0.205
	6–10	28(21%)	103(79%)	0.37(0.19–0.75)[a]	0.005	0.52(0.29–1.04)	0.281
	<5	80(39%)	125(61%)	1		1	
Marital status	Married	68(27%)	180(73%)	0.62(0.45–1.02)	0.346		
	Divorced	3(15%)	17(85%)	0.31(0.08–1.05)	0.459		
	Single	49(38%)	81(62%)	1			
Presence of handwashing setup	Yes	87(35%)	163(65%)	1.86(1.67–2.97)	0.009	2.30(1.38–3.83)	0.001[a]
	No	33(22%)	115(78%)	1		1	
Trained on hand hygiene	Yes	67(37%)	113(63%)	1.84(1.20–2.84)	0.005	2.25(1.40–3.62)	0.001[a]
	No	53(24%)	165(76%)	1		1	
Water availability in working room	Yes	59(33%)	118(67%)	1.31(0.85–2.02)	0.276		
	No	61(28%)	160(72%)	1			
Soap availability in working room	Yes	55(35%)	100(65%)	1.51(0.98–2.33)	0.365		
	No	65(27%)	178(73%)	1			
Presence of toilet near to working area	Yes	53(32%)	111(68%)	1.19(0.77–1.83)	0.431		
	No	67(29%)	167(71%)	1			
Presence of IPC committee	Yes	50(34%)	96(66%)	1.46(0.94–2.28)	0.489		
	No	66(26%)	186(74%)	1			
Knowledge about handwashing	Good	77(37%)	132(63%)	1.98(1.27–3.08)	0.002	1.83(1.14–2.94)	0.012[a]
	Poor	43(23%)	146(77%)	1		1	
Attitude toward hand hygiene	Positive	95(38%)	154(62%)	3.06(1.86–5.04)	0.000	3.52(2.07–5.98)	0.001[a]
	Negative	25(17%)	124(83%)	1		1	

[a]There is a significant association with the outcome.

could be attributed to variation in the study population, which in some cases focused solely on nurses or physicians, as well as the study period. These uncovered critical gaps among HCWs, urging immediate, targeted educational interventions to fortify adherence and prevent infection outbreaks (Hong & Xu 2024).

In this study, health professionals who have received in-service training about hand hygiene were 2.25 times more likely to have good hand hygiene compliance than those who have not taken the training. This finding is consistent with studies conducted in Finland (Ojanperä *et al.* 2020), Addis Ababa (Odo & Mekonnen 2021), Waghimira Zone (Alene *et al.* 2022), Hararghe Zone (Umar *et al.* 2022) and a study conducted in a university hospital in central Ethiopia (Pfäfflin *et al.* 2017). These all revealed that training has a significant relationship with hand hygiene compliance among health workers. This may be due to the fact that training builds the knowledge of healthcare providers and helps them to identify risk and benefits of HH practice on the ways of HCAI transmission and how to prevent it (Alene *et al.* 2022). Besides, factors like advanced professional level and in-service trainings provided in healthcare facilities could lead to a rise in hand hygiene compliance,

since health professionals received greater instruction on donning and doffing techniques (Chakma *et al.* 2024). Even a single lecture on basic hand hygiene protocols had a significant and sustained effect in enhancing hand hygiene compliance in a Swedish hospital (Sopjani *et al.* 2017).

Findings of this study showed that the study participants who had a handwashing facility setup in their working room were 2.3 times more likely to have good hand hygiene compliance as compared to those who had no handwashing facility setup in the working room/unit. This finding is consistent with a study conducted in Finland (Ojanperä *et al.* 2020), Gondar (Engdaw *et al.* 2019), and Waghimira Zone (Alene *et al.* 2022). It is apparent that handwashing set up is a pre-requisite for handwashing practice, and availability and accessibility of resources may promote hand hygiene compliance by increasing level of comfort during handwashing time (Ibrahim & Ibrahim 2020; Endalew *et al.* 2022). The current study exhibited that health professionals who had a BSc degree were 1.81 times more likely to have good hand hygiene compliance than those who had a diploma. This finding is consistent with studies conducted in Addis Ababa (Abdo *et al.* 2020), Gondar (Teshager *et al.* 2015) and Bangladesh (Hsan *et al.* 2023). This might be due to the fact that as educational level increases, knowledge of the importance of hand hygiene is also improved (Desta *et al.* 2018; Gammon *et al.* 2024).

Health workers who had good hand hygiene knowledge were 1.83 times more likely to have good handwashing compliance than their counterparts. This finding is consistent with studies conducted in central Gondor (Engdaw *et al.* 2019), Hararghe Zones (Umar *et al.* 2022), and Kuwait (Al-Wazzan *et al.* 2011). This could be because understanding the importance of hand hygiene enables one to follow suggested practices, weigh the benefits and drawbacks of doing so, and pinpoint the transmission routes and preventative measures for HCAIs (Chakma *et al.* 2024). Moreover, HCWs who had a favorable attitude toward hand hygiene were 3.52 times more likely to have good hand hygiene compliance as compared to their counterparts. This finding is consistent with similar studies conducted in Ethiopia (Soboksa *et al.* 2021), the United Arab Emirates (Wai Khuan *et al.* 2018), and Jordan (Al-Hussami *et al.* 2011). This might result from societal influences, religious institutions, positive peer pressure, positive professional attitudes regarding hand hygiene compliance, the respondent's educational background, or personal experience (Wai Khuan *et al.* 2018; Engdaw *et al.* 2019).

Strengths and limitations of the study

The strength of this study was that it shows the magnitude of hand hygiene compliance among health workers in rural primary healthcare facilities, which is very important to strengthen IPC strategies and practices between patients and HCWs. The study used primary data for obtaining comprehensive information from primary healthcare facilities, which are better accessible and most patients visit for various healthcare services. The main limitation of this study was that the results are based on a self-reported questionnaire. The study also had limitations such as temporality, and causal inferences could not be established because of the nature of the cross-sectional study design.

CONCLUSIONS

Nearly two-thirds of the healthcare providers had poor hand hygiene compliance in the study area. Lower professional level, lack of in-service training, limited knowledge, unfavorable attitude, and lack of WASH facilities have significant influences on health workers' hand hygiene compliance. Hence, the local government and other stakeholders should focus on improving the WASH services by availing all the basic facilities, and providing periodic training to build staff capacity in WASH.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Before starting the data collection process, the study protocol was approved by the Haramaya University, College of Health and Medical Sciences, IHRERC. Official letters of cooperation were written by Haramaya University College of Health and Medical Sciences to the Girawa District Office to obtain their cooperation in facilitating the study. 'Informed, voluntary, written, and signed consent' was obtained from all study participants after a clear description of the objectives, procedures, potential risks, and benefits of the study by the data collectors before proceeding with data collection. The study participants were informed of their right to refuse or withdraw from the study at any time. Privacy and confidentiality of participants were maintained by excluding names and identifiers in the questionnaire. Informed, voluntary, written, and signed consent was

obtained from all respondents throughout the study. This research was done following the Helsinki Declarations and National Ethical Guidelines.

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AUTHOR CONTRIBUTIONS

All authors participated in the development of the manuscript as well as the data review, drafting, methodology, data analysis, and writing the results. The final draft of the manuscript to be published has been read and approved by all authors, who also concur on all other aspects of this work.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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