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Research Article

Adherence to Infection Prevention Practice Standard Protocol and Associated Factors Among Healthcare Workers

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ABSTRACT

Introduction: Healthcare-associated infection affects more than 100 million patients annually. Healthcare workers' poor adherence to standard infection prevention and control procedures can result in many negative consequences, ranging from disability to death. **Methods:** A facility-based, cross-sectional study was conducted in June 2021 among 379 healthcare workers selected using a stratified random sampling technique. All types of healthcare providers except pharmacy professionals were included in the study. Standardization and validation of the study tool were performed ahead of data collection. Multivariable regression was used to assess the variables associated with adherence. **Results:** The study found that 60.2% of healthcare workers (95% CI, 55.1–65.2) had good adherence to infection prevention practices, and 68.7% and good knowledge of infection prevention practices. Training on infection prevention methods (adjusted odds ratio [AOR] = 1.68; 95% CI, 1.04–2.72), availability of water supply at hand washing station (AOR = 2.90; 95% CI, 1.62–5.31), and attitude toward infection prevention (AOR = 2.64; 95% CI, 1.65–4.24) were identified as predictors of adherence to infection prevention and control procedures. **Conclusion:** More than half of the participants had good adherence to infection prevention guideline practices. In-service infection prevention training, a consistent water supply at the hand washing station, and a positive attitude of participants were associated with good adherence to infection prevention practices.

Keywords: adherence, infection prevention, healthcare worker, Ethiopia

INTRODUCTION

Standard precaution (SP) is the first line of defense against exposure to blood and body fluids by strengthening infection prevention (IP) standards in the field of healthcare delivery.[1–3] SP is a series of procedures for preventing occasional exposures to and handling potentially infectious materials, such as wearing personal protective equipment and appropriate disposal of used needles. IP practices enable the entire hospital community to reach safe zones by preventing, controlling, and reducing healthcare-associated infections (HAI).[4]

IP plays a key role in reducing and controlling the rate of disease transmission.[4,5] For instance, HAIs occur frequently during hospital stays, manifesting after 48 hours of admission or within 3 or 30 days after discharge or operation, respectively.[6–9] Adherence to IP protocols is determined by the knowledge and practice of frontline professionals, the level of commitment invested by healthcare organizations, and strengthening adherence to

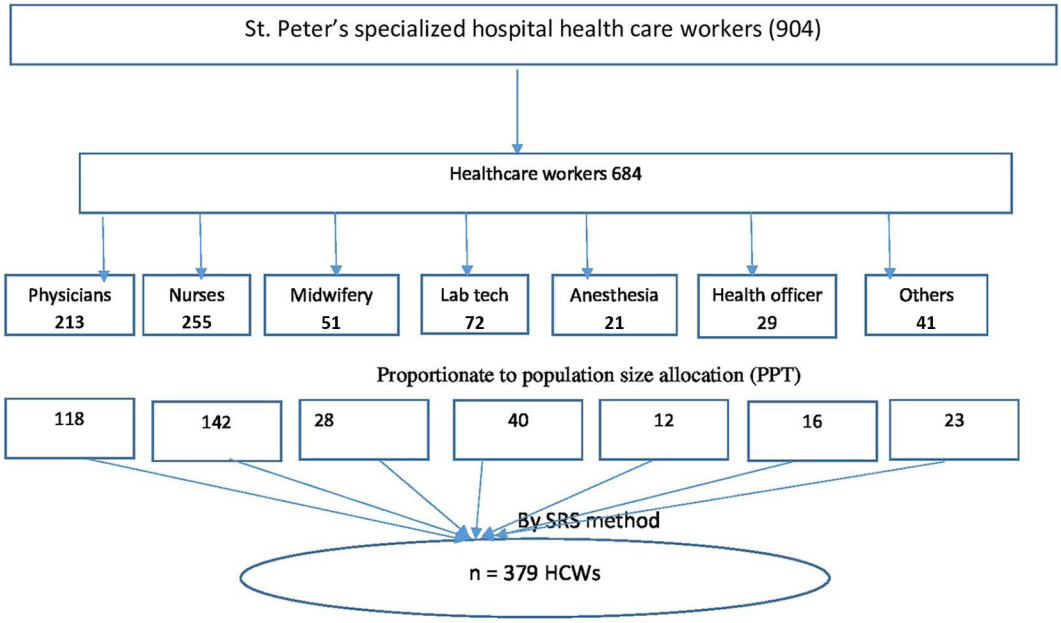

Figure 1. Schematic presentation of sampling procedure. Of the total sample population, 364 participated in the study (96% response rate). Others includes optometrists, radiographers, and pharmacists. HCWs: healthcare workers; SRS: simple random sampling.

mandatory SPs.[10] Thus, IP is a major component of safe and high-quality service delivery at health care facilities. Furthermore, IP protocols can reduce HAI-associated morbidity and mortality.[11–13]

Globally, 100 million patients are affected by HAIs annually.[14] HAIs are a global problem, especially in low socioeconomic countries. HAIs affect 30% of patients in high-income countries, whereas HAIs occur two to three times more frequently in low-income, developing countries.[15] Furthermore, 5–10% of hospitalized patients acquire one or more HAIs.[16] HAIs affect 3.2% and 6.5% of hospitalized patients in the United States and the European Union, respectively. In the United States, HAIs lead to 99,000 deaths and cost $33 billion yearly.[17,18]

According to a systematic review, the pooled prevalence of HAI from studies done in Algeria, Burkina Faso, Senegal, and the United Republic of Tanzania ranged from 2.5–14.8%.[19] Similarly, the pooled prevalence of HAI in Ethiopia is approximately 17% according to a systematic review and meta-analysis.[20] Moreover, 65.9% of healthcare workers (HCWs) in Ethiopia are exposed to blood and body fluids.[21]

Knowledge gaps among some healthcare professionals and poor initiation of postexposure prophylaxis make it challenging to estimate the prevalence of nosocomial infections worldwide.[22] Major contributing factors include poor adherence to SPs and inaccessibility of personal protective equipment (PPE).[23–26] In addition, infectious diseases have detrimental social and psychological impacts on patients and health systems.[27,28]

Owing to resource scarcity and poor adherence to standard protocol tracing in many Ethiopian hospitals, the number of patients and HCWs with HAI has been seen as challenging.[29–32] In addition to prolonged hospitalizations, high antibiotic resistance, lifelong disability, early death, the financial burden on health systems, and reduced work output by HCWs are the main negative consequences of nosocomial infection who develop HAI.[33]

SP are work practices that encompass policies, procedures, and activities performed aggressively to achieve the highest degree of infection control. It is realized by reducing the risk of infectious disease transmission in healthcare settings for all clients and HCWs, regardless of diagnosis and susceptibility.[2,34] For instance, safe antiseptic procedures when handling patients, hospital environmental sanitization areas, sterilization of instruments, on-the-job training, rational antibiotic therapy, and use of needle cutters are necessarily expected precautionary measures. Therefore, the failure of HCWs to adhere to SP and control procedures has resulted in many negative consequences ranging from disability to death. The resulted from individual knowledge, attitude, work-related, workload, and institutional factors.[21,35–37]

Ethiopia's federal Ministry of Health is focusing on developing IP standards and guidelines to protect patients and medical professionals from HAIs. Thus, currently emerging and reemerging diseases have made standard infection-controlling precaution practices more than ever. To enforce these IP principles and improve practice, nurses must have adequate knowledge of IP protocols and identify gaps for better improvement.[22]

METHODS

The institutional review board of the College of Health Sciences and Medicine of Saint Peter Specialized Hospital reviewed overall protocols and approved the study, and informed consent was obtained from all study participants.

Study Setting and Design

An institution-based, cross-sectional study was conducted among HCWs of Saint Peter Specialized Hospital, Addis Ababa, Ethiopia, from June 15– 30, 2021. The hospital is located in the mountains of Entoto, north of Gulele. It was established by Emperor Haile Selassie in 1955. Currently, it provides multidimensional healthcare services in both inpatient and outpatient departments. The hospital has 1472 staff, of which 1197 are HCWs, and 293 are supportive staff.

Sample Size Determination and Sampling Technique

The sample size for this study was estimated by employing the single population proportion formula. For the first specific objective (considering the proportion of adherence) and for the second objective (considering variables significantly associated with the outcome variable). Then, the sample size estimation approaches yielded a larger sample picked as the final sample size. Finally, the desired sample size for this study was estimated by taking a prevalence of good IP practice (66.1%) from a study conducted in Addis Ababa[37] and using the following assumptions: 95% CI (for normal distribution with the corresponding value 1.96 at $\alpha = 0.05$) and 5% margin of error. The total calculated sample size was 342; to compensate, a nonresponse rate of 10% was added, and the final estimated sample size was 379.

Before selecting study units, stratification was done based on the professional's disciplines. First, a temporary sampling frame was developed for each discipline by taking the list of HCWs from the health management information system and human resource directorate. Second, an estimated sample was divided by the total target population for the study, which yields the *p*-value. Third, the proportionate value multiplied by the total number of HCWs in the respective disciplines gave a quota for each department. Finally, study participants were selected using a simple random sampling technique by applying the lottery method (Fig. 1).

Source and Study Population

Study participants included all healthcare providers with the exception of pharmacy and health informatics. HCWs on maternity and annual leave were excluded from the study. All types of HCWs at our hospital and were randomly selected from each department in the hospital.

Table 1. Characteristics of study participants ($N = 364$)

Sociodemographic Variables	Frequency *n* (%)
Sex	
Male	214 (58.8)
Female	150 (41.2)
Age	
≤ 25 y	57 (15.7)
26–30 y	267 (73.4)
> 30 y	40 (11.0)
Profession	
Nurse	140 (38.5)
Midwife	287 (7.7)
Physician	110 (30.2)
Laboratory	40 (11.0)
Anesthetist	11 (3.0)
Health officer	12 (3.3)
Other professional	23 (6.3)
Educational status	
Diploma	12 (3.3)
Bachelor of Science Degree	198 (54.4)
Medical Doctors	110 30.2)
Masters Degree	44 (12.1)
Work experience	
≤ 5 yr	269 (3.9)
> 5 yr	95 (26.1)
Department or unit	
Emergency	41 (11.3)
Pediatric wards	29 (8.0)
Medical wards	36 (9.9)
Surgical wards	29 (8.0)
Operation room	44 (12.1)
NICU	19 (5.2)
ICU	25 (6.9)
OPD	31 (8.5)
MCH	41 (11.3)
Laboratory	40 (11.0)
Other units*	29 (8.0)
Monthly income, Ethiopian Birr	
3000–4500	20 (5.5)
4501–8000	208 (57.1)
8001–10,000	109 (29.9)

*Other units include psychiatric wards, gynecology wards, toxicology units, cardiac center and multidrug resistance units.
HCW: healthcare worker; BSc: Bachelor of Science; MSc: Master of Science; MPH: Master of Public Health; NICU: neonatal intensive care unit; ICU: intensive care units; OPD: outpatient department; MCH: maternal and child health.

Data Collection Tool and Procedure

The study tool (a self-administered questionnaire) was adapted from published literature and had three main parts. The first part contained general issues of socio-demographics. The second and central part of the study was organized into three subsections: knowledge, attitude, and practice toward adherence to standard IP protocols. The third part of the study tool consists of items related to the factors that affect adherence. To assess adherence to standard IP protocols, 11 institutional and individual variables were used. Similarly, standardized questionnaires were developed to assess the level of knowledge and attitudes of participants. The survey was prepared in

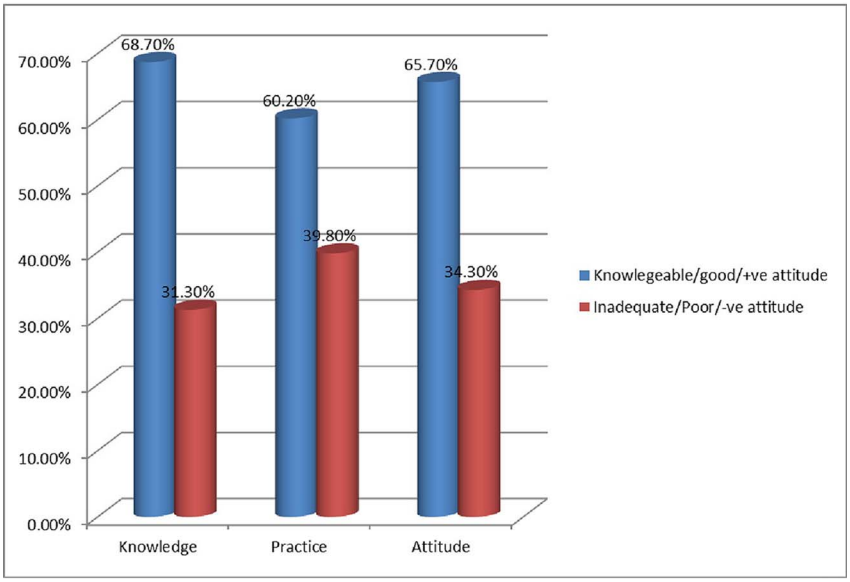

Figure 2. Frequency distribution of knowledge, attitude, and practice (KAP) of adherence with infection practices among healthcare workers at the Saint Peter Specialized Hospital in Addis Ababa, Ethiopia, 2021 (N = 364). −ve: negative; +ve: positive.

English, then translated into Amharic and back to English by another translator before the survey was sent to participants.[28,38,39] Data were collected by two HCWs under the supervision of the principal investigator.

Data Quality Control, Processing, and Statistical Analysis

A pretest on the study tool was done on 5% (19 healthcare professionals) of the sample at Hawassa University Referral Hospital to assure data quality, where there is a similar setting. To determine the internal consistency of the questions designed to assess knowledge, attitude, and IP practice, the reliability (Cronbach's alpha) test was done. Their reliability coefficients were 0.73, 0.70, and 0.81 for knowledge, attitude, and practice items, respectively. For knowledge and practice assessments, mean scores were computed for each survey question. Questions with multiple responses were re-categorized into dichotomous variables (coded as 1 for the correct answer or 0 for incorrect answers), then summed to calculate an overall mean value of the respondents. Using the mean value as a cutoff point, the respondent's level of knowledge and practice was determined. For attitude assessment, a 5-point Likert scale (1 indicated strongly disagree and 5 indicated strongly agree) was used. Using the mean value as of cutoff point, the respondent's attitude was categorized as favorable/positive or unfavorable/negative. The completeness of the data was cross-checked by data collectors and supervisors daily.

All checked and cleaned data were coded and entered into the software Epi-data version 4.6 and then exported to SPSS (statistical packages for social science) version 25 for further data processing and analysis. Before analysis, data were cleaned and checked for outliers and missing values. Skewness and kurtosis were performed to look for symmetry and distribution of data. Model fitness was checked by applying Hosmer Lemeshow goodness-of-fit, which was 0.57, and the multicollinearity effect was performed by using the variance inflation factor. It revealed that there is no multicollinearity effect. Then, logistic regression was done for those variables that fulfilled the statistical assumption in cross-tabulation. After descriptive analysis, bivariate logistic regression was performed to select candidate variables for the next model. All variables with p-values less than 0.25 were fitted into the backward stepwise multivariable logistic regression model. Finally, independent predictors were determined on the basis of an adjusted odd ratio (AOR) with a 95% CI at a p-value less than 0.05.

Operational Definitions

Adherence to IP guidelines and protocols was defined as using the available resources (i.e., IP guidelines, evidence, and recommendations) to reduce HAIs and by answering "yes" to all questions developed to assess adherence to those guidelines. For knowledge, attitude, and practice-related questions, scores at or above the median were considered to indicate adherence to IP protocols and scores below the median were considered not adherent.

RESULTS

Socio-Demographic Characteristics

Of the total 379 sampled populations, 364 took part in the study, yielding a response rate of 96.04%. Participants ranged from 22 to 45 years old (mean ± SD, 28.28 ± 3.90 years), and most participants (73.4%) were between the ages of 26 and 30 years. Nearly two-thirds (58.8%) of participants were men. More than one-fifth (26.1%) of the

Table 2. Survey questions related to infection prevention practices ($N = 364$)

Questions and Possible Responses	Frequency, *n* (%)
There is a hand washing station with soap, running water, and disposable towel	
No	317 (87.1)
Yes	47 (12.9)
Consistent daily water supply	
No	280 (76.9)
Yes	84 (23.1)
The institution provides in-service training/workshops related to infection prevention and control	
No	235 (64.6)
Yes	129 (35.4)
How long ago did you take infection prevention training?	
≤ 6 mo	42 (11.5)
6 mo–1 y	25 (6.9)
> 1 y	62 (17.0)
Staff adherence to infection prevention practices is monitored by infection prevention committees	
No	153 (42.0)
Yes	211 (58.0)
Adequate supplies of resources (sterile needles and syringes, gloves, sharp containers, disinfectants, hand sanitizers, etc) to work within your department	
No	283 (77.7)
Yes	81 (22.3)
Personal protective equipment is always accessible	
No	299 (82.1)
Yes	65 (17.9)
The facility ensures that isolation rooms for patients with airborne and droplet infections	
No	173 (47.5)
Yes	191 (52.5)
Be aware of the existence of infection prevention and control guidelines in your institution	
No	89 (24.5)
Yes	275 (75.5)
Do you have access to the documents or guidelines?	
No	105 (28.8)
Yes	170 (46.7)
I am not able to follow standard precautions frequently because of: (please tick all that apply)	
High workload	
No	202 (55.5)
Yes	162 (44.5)
Don't have enough time	
No	235 (64.6)
Yes	129 (35.4)
Forgetfulness	
No	267 (73.4)
Yes	97 (26.6)
None applies to me	
No	314 (86.3)
Yes	46 (12.6)
I am vaccinated for hepatitis B virus	
No	101 (27.7)
Yes	263 (72.3)
The reason for not being vaccinated against the hepatitis B virus	
The facility did not provide an opportunity	73 (20.1)
Refuse to take vaccination	28 (7.7)

participants had 5 or more years of work experience. Minimum and maximum monthly incomes were 3000 and 15,000 Ethiopian Birr (ETB), and most respondents had 4501 to 8000 ETB monthly incomes (Table 1).

The study included healthcare providers with different educational statuses (from diploma holders to medical directors). More than half (54.4%) of them had a Bachelor of Science degree. The study findings revealed that healthcare providers' adherence to IP increases with their educational status (Fig. 2).

Factors Influencing Adherence to IP Guidelines and Protocols

The highest (87.1%) poor adherence to SPs reported was the inaccessibility of a hand washing station with soap and water, whereas 75.5% of HCWs adhered to the availability of IP and controlling guidelines within an institution. However, only 23.1% of HCWs responded that a consistent water supply was accessible in their institution daily. A high proportion (44.5%) of participants justified that they were unable to follow IP SPs because of a high working load (Table 2). The presence of a hand washing station with soap, consistent water supply, adequate material supplies for IP, workload, vaccination status for hepatitis B virus, and attitude toward IP were statistically significant in the bivariate logistic regression model (95% CI p-values < 0.25). A consistent water supply at a hand washing station increased the odds of adherence to IP practices protocols by 3-fold (AOR = 2.90; 95% CI, 1.62–5.20).

Table 3. Summary statistics of KAP score toward adherence to IP protocol among HCWs in Saint Peter Specialized Hospital

Outcome Variable	Mean ± SD	Range	Mean Percentile (25%, 50%, 75%)
Knowledge	14.44 ± 2.68	7–20	13, 15, 16
Attitude	3.47 ± 1.29	1.63–4.87	24, 28, 32
Practice	7.07 ± 1.51	2–11	6, 7, 8

KAP: knowledge, attitude, and practice; IP: infection protocol; HCWs: healthcare workers.

The multivariable analysis was used to identify factors that predict adherence to IP protocols. Training on IP methods, consistent water supply, and attitude towards IP were significantly associated with adherence to IP protocols.

The odds of good adherence to IP guideline practices among HCWs who had training on IP methods was approximately 1.7 times that of HCWs who did not take IP training (AOR = 1.68; 95% CI, 1.04–2.72). Participants with a positive attitude toward IP practices also had 64% higher (AOR = 2.64; 95% CI, 1.65–4.24) adherence to IP practice protocols compared to those with a negative attitude (Tables 3 and 4).

Knowledge, Attitude, and Practice of Healthcare Workers Toward Adherence to IP Standards Precautions

The mean (± SD) level of knowledge of standard IP protocols was 14.43 ± 2.68. Participants who scored above the mean were categorized as knowledgeable, and those scoring below the mean were categorized as having inadequate knowledge. Most participants (68.7%) were knowledgeable on standard IP protocols and had a positive attitude (65.7%) regarding adherence to those guidelines. The median score for adherence to IP protocols in practice

Table 4. Factors associated with adherence to IP guideline practices among HCWs in Ethiopia (N = 364)

Variable	Category	Adherence to IP protocol (no. of participants)		p	COR (95% CI)	AOR (95% CI)
		Good	Poor			
Age	≤ 25 y	29	28		1.00	1.00
	26–30 y	162	105	0.17	1.49 (0.83–2.64)	1.06 (0.52–2.15)
	> 30 y	28	12	0.06	2.25 (0.96–5.28)	1.74 (0.59–5.10)
Marital status	Unmarried	109	88	0.06	1.00	1.00
	Married	110	57	0.04	1.55 (1.01–2.38)*	1.50 (0.96–2.35)
Monthly income (Ethiopian Birr)	3000–4500	12	8		1.00	
	4501–8000	124	84	0.97	0.98 (0.39–2.51)	
	8001–10,000	68	41	0.84	1.106 (0.42–2.93)	
Department or unit	Emergency	27	14		1.00	1.00
	Pediatrics	21	8	0.56	1.36 (0.48–3.84)	1.09 (0.34–3.47)
	Medical	20	16	0.35	0.64 (0.25–1.62)	0.71 (0.25–2.01)
	Surgical	15	14	0.23	0.55 (0.21–1.47)	0.49 (0.16–1.44)
	OR	29	15	0.99	1.0 (0.40–2.45)	0.84 (0.30–2.32)
	NICU	11	8	0.55	0.71 (0.23–2.17)	0.58 (0.17–1.93)
	ICU	13	12	0.26	0.56 (0.20–1.55)	0.51 (0.16–1.56)
	OPD	21	10	0.86	1.08 (0.40–2.93)	0.86 (0.29–2.54)
	MCH	23	18	0.36	0.66 (0.27–1.61)	0.47 (0.17–1.26)
	Laboratory	26	14	0.93	0.96 (0.38–2.40)	0.89 (0.32–2.46)
	Other units	13	16	0.08	0.42 (0.15–1.11)	0.41 (0.13–1.22)
Trained on IP methods	No	133	102		1.00	1.00
	Yes	86	43	0.06	1.53 (0.98–2.49)*	1.68 (1.04–2.72)*
Presence of hand washing station with soap and water	No	186	131		1.00	1.00
	Yes	33	14	0.13	1.66 (0.85–3.22)	1.81 (0.85–3.85)
Consistent water supply	No	155	125			
	Yes	64	20	0.001	2.58 (1.48–4.49)	2.90 (1.62–5.20)**
Organization standards for adherence to IP	Poor	181	129		1.00	
	Good	38	16	0.100	1.69 (0.91–3.17)	
		Mean 5.74 (SD ± 1.80)				
Attitude toward infection prevention	Negative	59	66		1.00	1.00
	Positive	160	79	0.001	2.26 (1.45–3.52)	2.64 (1.65–4.24)**
		Mean 3.47 (SD ± 1.29)				
Knowledge	Inadequate knowledge	65	49		1.00	
	Good knowledge	154	96	0.41	1.21 (0.77–1.89)	
		Mean 14.43 (SD ± 2.63)				

*The variable had association in multivariate analysis.
**The variable is statistically significant in bivariate regression.
IP: infection protocol; HCWs: healthcare workers; COR: crude odds ratio; AOR: adjusted odds ratio; OR: operating room; NICU: neonatal intensive care unit; ICU: intensive care units; OPD: outpatient department; MCH: maternal and child health.

was 7.0, and most participants (60.2%) were considered to have good adherence (Fig. 2). Among participants who were considered knowledgeable, 59.6% of them adhered to IP practice protocols, whereas 66.9% of those with a positive attitude also adhered to IP protocols.

DISCUSSION

In this study, the proportion of HCWs who had good adherence toward IP practice was 60.2% (95% CI, 55.1–65.2), which is consistent with related studies conducted in Rivers State (59%),[40] Rwanda (64.5%),[41] Lesotho (63.6%),[42] and in different parts of Ethiopia (57.4%,[43] 57.3%,[44] 60.5%,[45] and 65%[34]). This finding was higher than similar studies conducted in Bangladesh (36%),[46] Iran (34%),[47] Elele, Nigeria (50.8%),[48] Ghana (45.1%),[49] and other parts of Ethiopia (42.9%).[50] This variability could be related to differences in sample size, study period, survey design, and socio-demographic factors (e.g., income status). Ethiopia is a low-income country where nurses may not receive training in IP, and an inadequate supply of materials and hand washing stations may lead to poor practices for preventing HAI.

HCWs with training in IP methods are 1.7 times more likely to adhere to IP guidelines than those who have not been trained (AOR: 1.67, 95% CI: 1.04–2.72), which is in line with a study conducted in Debre Markos, Ethiopia.[39] Trained HCWs know the advantages of adhering to IP guidelines and other critical information, allowing for implementation of IP protocols with existing resources to prevent the negative impacts of infectious disease spread in the healthcare system. Having knowledge and skills in IP may also boost nurses' confidence in complying with recommended guidelines.

The odds of having good adherence to IP guideline practices among HCWs who had regular water supply at hand washing stations were approximately three times higher than HCWs who lack consistent water supply at hand washing sinks in their institution. This finding is supported by related studies conducted in Bale and Addis Ababa, Ethiopia.[28,37] Access to a consistent water supply for hand hygiene for HCWs is important for preventing infections.

Participants with a positive attitude are 2.6 times more likely to adhere to standard IP guidelines, which is consistent with the study in Addis Ababa, Ethiopia.[37] This study indicated that a positive attitude toward IP practices is the key to achieving good IP practices in healthcare facilities. Therefore, behavioral factors, such as the attitudes of HCWs, can have an impact on efforts to reduce HAIs through adherence to IP protocols.

CONCLUSIONS

This study found that more than half of HCWs adhered to IP protocols. Having good knowledge and a positive attitude about IP guidelines contributes to adherence to IP protocols. Training in IP methods and availability of a consistent water supply were also identified as predictors of good adherence to IP protocols. Therefore, providing on-the-job training, maintaining organizational structure, and supporting staff to have a decent perception of IP-related activities should be considered to achieve good adherence to IP protocols.

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Data Availability

Complete study data are available upon request by contacting the corresponding author.

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