

# Infection Prevention Knowledge, A practice, And Its Associated Factors Among Healthcare Providers

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## Abstract

**Background:** Adequate knowledge and safe practice of infection prevention among healthcare providers (HCPs) are vital to prevent nosocomial infections. Thus, this study aimed to assess the level of knowledge and practices of HCPs towards infection prevention and its associated factors in the health facilities. **Methods:** Institution based cross-sectional study was conducted among 171 HCPs who were selected by a simple random sampling technique. Data were collected using interviewer-administered questionnaire. Multivariable logistic regression was performed to identify factors associated with knowledge and practice of infection prevention. **Result:** About 70.8 and 55.0% of HCPs had adequate knowledge and safe practice of infection prevention respectively. Having infection prevention guideline (AOR = 3.65, 95% CI; 1.26, 10.54), taking infection prevention training (AOR = 2.2, 95% CI; 1.01, 4.75), having five years or more work experience (AOR = 1.52: 95%CI; 1.13, 4.51), and working in maternity unit (AOR = 1.67:95%CI; 1.38–5.23) were positively associated with adequate knowledge of infection prevention. The odds of safe practice were higher in participants who received infection prevention training (AOR: 2.4; 95% CI; 1.01, 4.75) but lower among HCPs who are working in the facility which has no continuous water supply (AOR = 0.48:95% CI; 0.21, 0.83). **Conclusion:** A significant proportion of HCPs had inadequate knowledge and unsafe practice of infection prevention. To improve healthcare worker's knowledge of infection prevention, adequate pre-service as well as on job training should be given.

**Keywords:** Knowledge, Practice, and Infection prevention.

## Introduction

Healthcare-associated infection (HAI) is defined as infections acquired in the healthcare facilities during the clinical, diagnostic and therapeutic procedure that was not present at the time of the client's admission<sup>(1)</sup>. It is a main problem encountered in healthcare delivery services worldwide and constitutes one of the most important causes of morbidity and

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mortality<sup>(1-3)</sup>. A systematic review of the literature reported that the pooled prevalence of healthcare associated infection was 7.6% in high-income countries and 10.1% in low and middle- income countries<sup>(4)</sup>. In Africa, the prevalence of HAI was significantly high (12–35%)<sup>(5-8)</sup>. However, awareness of the problem remains extremely limited because of other health priorities take precedence over infection prevention and patient safety considerations<sup>(4)</sup>. Most of the HAI are caused by the transmission of pathogens from one patient to another, especially by healthcare workers who failed to practice infection prevention measures consistently<sup>(9-12)</sup>.

Many studies have shown that significant proportion of healthcare providers (HCPs) had inadequate knowledge on infection prevention. Only 58% of health care workers in Ghana<sup>(13)</sup> and 70–80% in Nigeria<sup>(14, 15)</sup> had adequate knowledge about infection prevention. Similarly, past evidence in Ethiopia showed that merely 54–60% of healthcare providers had adequate knowledge about infection prevention<sup>(16-18)</sup> and only 32–55% of healthcare providers demonstrated a safe practice on infection prevention<sup>(15, 17, 19)</sup>. Studies have shown that different factors such as availability of infection prevention guidelines, training on infection prevention and availability of personal protection equipment can promote safe infection prevention practices at the hospital level<sup>(16-18, 20-23)</sup>.

However, the factors associated with knowledge and practice of infection prevention in the health care of KSA need more attention. The Ministry of Health started initiatives to protect patients and health workers from healthcare associated infection by setting infection prevention standards and guidelines. Adequate knowledge of infection prevention is crucial to implement these infection prevention standards and to improve infection prevention practice. However, very little has been published on the level of knowledge and practices towards infection prevention among health workers. Therefore, this study aimed to assess the knowledge and practices towards infection prevention and its associated factors among healthcare providers.

## Methods

Institutional-based cross-sectional study design was conducted **from January to April 2023 in Najran General Hospital, KSA**. The sample size was determined by using single population proportion formula by considering the proportion of practices on infection prevention method 87.5%<sup>(24)</sup> using the assumptions: 95% confidence interval, 5% margin of error. The calculated sample size was 162 but after adding a 5% non-response rate, the final sample size became 171. A simple random sampling technique was used to select the representative subjects from all healthcare providers.

The outcome of interest was knowledge (adequate/inadequate) and practice (safe/unsafe) towards infection prevention. Independent variables include socio-demographic characteristics, water supply, presence of infection prevention committee, presence of infection prevention guidelines in a health facility and training on infection prevention. Knowledge of infection prevention was computed from 11 questions. The mean value was used to classify HCWs infection prevention knowledge as having adequate knowledge if the score was equal or above the mean. Respondents who scored less than the mean value of correct answers were classified as having inadequate knowledge on the infection prevention.

Infection prevention practices of HCPs were assessed for main components of infection prevention measures like hand hygiene practices, utilization of personal protective equipment (PPE), and post-exposure prophylaxes (PEP), healthcare waste management practices, and instrument disinfection practice. Respondents were asked to indicate the frequency of use (practice) for these 7 infection prevention measures. Practice assessment questions had either three or two possible alternative responses (“Always” or “Yes”,

“Sometimes” and “Never” or “No”). One point was given for each acceptable or correct practice and zero point for all other responses. Practice scores were summed up to give a total practice score for each health-care worker. Therefore, the total score of practice questions ranging from zero (all prevention measures not practiced safely) to seven (all infection prevention measures practiced safely) were classified into two categories of response: safe practice (equal or above the mean) and unsafe practice (below the mean)<sup>(25, 26)</sup>.

The researchers collected the data through face to face interview using a structured and pre-tested questionnaire which was prepared in the local language (Arabic). The tool was developed after reviewing related kinds of literature<sup>(2, 17, 18, 24, and 27)</sup>. To assure the data quality, data collection instruments were pre-tested on 10% of the sample. For each component, a reliability test was done. The reliability coefficient for practice and knowledge items had a Cronbach’s Alpha value of 0.832 and 0.753 respectively. The data were examined for completeness and consistency during data collection on a daily base by the supervisor.

Data were entered and analyzed by SPSS version 28. Before analysis, data were cleaned and checked for outliers and missing’s. Logistic regression was done and variables with a P-value of less than 0.2 at bi-variable logistic regression model were entered into the multivariable logistic regression model. In all cases, p-values of less than 0.05 were considered as statistically significant.

## Result

### Socio-demographic characteristics

**Table (1)** shows a total of 171 study participants were included and the mean age of the study participants was 27.98 with  $SD \pm 3.56$  years. Of the total participants, 119 (69.6%) of them were males and the majority 110 (64.3%) were married. About 83(48.5%) study participants were Nurses regardless of their educational level. In terms of educational status, 102 (59.6%) study participants were diploma and nearly one-third of respondents were currently working at the outpatient clinics.

**Table (2)** shows more than two-thirds of health facilities had infection prevention committee and around 73% of health facilities had infection prevention guidelines. About 33(19.3%) study participants didn’t take any training on infection prevention and universal precaution.

### Knowledge of health care providers on infection prevention

**Table (3)** shows 70.8% of participants had adequate knowledge about infection prevention. Sixteen (9.4%) were believed that gloves cannot provide complete protection against acquiring infection. One hundred sixty-three (95.3%) of the study participants responded that washing hands with soap or an alcohol-based antiseptic decreases the risk of transmission of hospital acquired pathogens.

**Table (4)** shows that practice of HCPs on infection prevention, 55% of HCPs had safe infection prevention practice. From all participants, 68.4% wash their hands before patient care and 77.2% used soap to wash their hands. Around 50.3% of healthcare providers have used all personal protective equipment’s and 90.6% participant changes chlorine solution every 24 h.

### Factors associated with knowledge of infection prevention

In this study, all variables with a P-value of less than 0.2 at bivariate logistic regression model were included in the multivariable analysis. Thus age, sex, educational status, profession, work experience, presence of infection prevention guideline, getting of

infection prevention training, availability of continuous water supply, and currently working unit were evaluated as possible factors associated with knowledge of infection prevention. In multivariable analysis presence of IP guidelines, IP training, work experience and currently working unit were significantly associated with knowledge of infection prevention ( $P < 0.05$ ).

The odds of having adequate knowledge of infection prevention among health care providers who have IP guidelines in their health institutions were 3.7 times higher (AOR: 3.65, 95% CI; 1.26, 10.54) than those who have not IP guideline. The odds of having adequate knowledge towards infection prevention were higher in health worker who has trained about infection prevention (AOR = 2.19: 95% CI; 1.01, 4.75) than those who were not trained. Similarly, participants who had more than 5 years' work experience had higher odds of having adequate infection prevention knowledge (AOR = 1.52: 95% CI; 1.13–4.51). Healthcare providers who were currently working in maternity and laboratory unit had higher odds of having adequate knowledge about IP ((AOR = 1.67:95% CI; 1.38– 5.23), (AOR = 2.56:95% CI; 1.26–4.13)) respectively (**Table 5**).

### **Factors associated with infection prevention practice**

In this study, age, sex, educational status, profession, work experience, presence of infection prevention guideline, getting of infection prevention training, availability of continuous water supply, type of health center and currently working unit were evaluated as possible factors associated with safe infection prevention practices. But, Getting infection prevention training and the availability of continuous water supply in the health facility were significantly associated ( $P < 0.05$ ) with safe infection prevention practices in the multivariable analysis. HCPs who have trained on infection prevention were 2.2 times (AOR: 2.19, 95% CI; 1.01–4.75) more likely to have good practice than those who were not trained. The odds of safe infection prevention practices were 52% lower among healthcare providers who work in health facility which have not continuous water supply (AOR = 0.48:95% CI; 0.214–0.832) than their counterparts (**Table 6**).

### **Discussion**

Adequate knowledge about infection prevention is vital in reducing HAI. The finding in this study suggested that approximately one-third of HCPs demonstrated inadequate knowledge about infection prevention. This finding is supported by previous studies<sup>(14, 16, 28)</sup> done in different parts of Africa. But it was low when compared with studies done in Ethiopia<sup>(17, 23)</sup>. This discrepancy may be due to differences in the study settings. The majority of previous studies were done at teaching and referral hospitals but this study was limited to the primary healthcare units (health centers). In teaching and referral hospitals healthcare providers might get the opportunities for various infection prevention training which could increase knowledge level about infection prevention<sup>(14, 29)</sup>.

Even though MOH of Ethiopia is scaling-up its activities related with infection prevention, the current study showed that only 55% of healthcare providers had safe infection prevention practices. This finding was in line with a study done in Bahir-Dar<sup>(23)</sup> but lower when compared with studies done in other parts of Ethiopia<sup>(24, 30)</sup>. The discrepancy might be due to a difference in the study setting and composition of healthcare providers<sup>(24)</sup>. In Ethiopia, the composition of health worker staffs was different among hospitals and primary healthcare unit. Majority of health workers in hospitals were experienced and specialized which might improve their practice towards infection prevention. This finding implies that improving safe infection prevention practices are vital in primary healthcare units of Ethiopia where a high proportion of patients developed healthcare associated infection<sup>(31)</sup>.

Remarkably, in the current study, about 90% of health care providers believed that gloves can't provide complete protection against acquiring infection. This finding is higher than previous studies done in Ethiopia<sup>(17, 18)</sup> and Eritrea<sup>(32)</sup>. As similar to previous studies done in Ethiopia<sup>(17, 27)</sup>, in this study, only one-third of healthcare providers had hand hygiene practice after patient care and 68.4% of healthcare workers wash their hands before patient care. This study revealed that healthcare providers who had more than five years of work experience were 1.5 times more likely to have adequate knowledge than their counterparts. This is in line with findings from Ethiopia<sup>(17, 25)</sup>. This might be due to the fact that as the number of years of practice increases, healthcare providers are exposed to infection prevention information and became more experienced through working with senior staff.

According to WHO recommendation, all primary healthcare facilities should develop their own standard operating procedures based on national infection prevention and control guidelines<sup>(33, 34)</sup>. Developing and implementation of infection prevention guidelines is one of the core components of infection prevention and control programs at all healthcare facilities<sup>(33, 34)</sup>. In this study, similar to previous studies<sup>(18, 22)</sup>, the presence of infection prevention guidelines in health institutions also increases the odds of having adequate knowledge about infection prevention. This might be attributed to the fact that healthcare workers who have infection prevention guidelines were more likely to get updated information, which improves their knowledge of infection prevention.

Healthcare providers who are currently working in maternity and laboratory unit had higher odds of having adequate knowledge about IP. This might be due to the availability of infection prevention standard operating procedures in the laboratory unit which might improve their knowledge. Besides, this could be due to the difference in infection prevention training among units. Health workers who had ever attended any form of training program on infection prevention were more likely to practice than those who didn't take training on infection prevention. This is supported by a study done in Ethiopia<sup>(18)</sup>. According to different international guidelines, infection prevention education & training is the core components of infection prevention and control programs<sup>(33, 34)</sup>.

Infection prevention and control guidelines in combination with health care workers' education and training are effective to reduce hospital acquired infection<sup>(34)</sup>. Previous studies have verified that training of health care workers on infection control has a valuable effect on healthcare staff by improving their compliance with the standard precaution<sup>(35, 36)</sup>. But the current study showed that only 33.9% of the health workers had ever attended any form of training program on infection prevention. This implies more than two-third of healthcare providers need training for infection prevention. Similarly, healthcare providers who had infection prevention guidelines were more likely to have safe infection prevention practice than those who had no infection prevention guidelines. The finding highlights the necessity of infection prevention guideline in the improvement of healthcare providers' practice.

Healthcare providers working in health facilities without continuous running water supply were 52% less likely to have safe infection prevention practices as compared with HCPs working in a facility with continuous water supply. This finding is supported by a study done in Ethiopia<sup>(30)</sup>. One of the limitations of this study was temporal relationships cannot be established between the explanatory and outcome variables due to the cross-sectional nature of study design. Recall bias might be the other limitation of this study. Finally, since the study was conducted in governmental healthcare facilities, generalizability of the study findings is limited to these governmental healthcare facilities.

Conclusion

The findings of this study showed that a significant proportion of HCPs had no adequate knowledge on infection prevention and 45% of healthcare providers practiced infection prevention unsafely. Knowledge towards infection prevention has been significantly associated with work experience, getting of infection prevention training and presence of infection prevention guideline. As a result, to improve knowledge on infection prevention, adequate pre-service as well as on job training for HCPs should be given. Besides, infection prevention guideline should be availed to improve knowledge and practice of infection prevention.

**Table (1):** Socio-demographic characteristic of HCPs

<b>Variables</b>	<b>Category</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Age</b>	18–27	84	49.1
	28–37	82	48.0
	38–47	5	2.9
<b>Sex</b>	Male	119	69.6
	Female	52	30.4
<b>Marital status</b>	Married	110	64.3
	Single	61	35.7
<b>Profession</b>	Nurse	68	39.8
	Midwifery	33	19.3
	Health Officer	26	15.1
	Laboratory technologist/technician	29	17.0
	Pharmacist/pharmacy-technician	15	8.8
<b>Educational status</b>	Degree and above	69	40.3
	Diploma	102	59.7
<b>Work experience in health facility</b>	Less than 5 years	114	66.7
	> = 5 years	57	33.3
<b>Currently working unit</b>	Outpatient department	51	29.8
	Emergency and Triage	22	12.9
	Maternity unit	33	19.3
	Inpatient clinic	13	7.5
	Laboratory	29	17.0
	Pharmacy	15	8.8
	Under-five clinic	8	4.7

**Table (2):** Characteristic of HCPs

Characteristics	Category	Frequency	Percentage (%)
Type of health facility	Rural Health center	98	57.3
	Urban health center	73	42.7
Members of infection prevention committee	Yes	119	69.5
	No	52	30.5
Access infection prevention guideline	Yes	124	72.5
	No	47	27.5
Infection prevention training	Yes	58	33.9
	No	113	66.1
Availability of continuous water supply	Yes	88	51.5
	No	83	48.5

**Table (3):** Knowledge questions for HCPs in health facilities

Knowledge Variables	Category	Frequency	Percentage (%)
Have you heard about infection prevention principle?	Yes	171	100
	No	0	0
Do you think that gloves cannot provide complete protection against acquiring/transmitting infection?	Yes	155	90.6
	No	16	9.4
Do you think that healthcare-associated pathogens can be found on normal and intact patient skin?	Yes	163	95.3
	No	18	4.7
Do you think that washing your hands with soap or alcohol-based antiseptic decreases the risk of transmission of hospital acquired infection?	Yes	163	95.3
	No	8	4.7
Do you think that use of an alcohol-based antiseptic for hand hygiene is as effective as soap and water if hands are not visibly dirty?	Yes	168	98.2
	No	3	1.8
Do you think that gloves reduce the contamination of the hand but do not prevent it completely?	Yes	137	80.1
	No	34	19.9
Do you think that no need to wash hands before doing procedures that do not involve bodily fluids?	Yes	33	19.3
	No	138	80.7
Do you think that no need to wear the same pair of gloves for multiple patients as long as there is no visible contamination?	Yes	130	76.0
	No	41	24
Do you think TB is carried in airborne particles that are generated from patients with active pulmonary TB?	Yes	169	98.8
	No	2	1.2
Do you know to what level safety boxes should be filled before closing and sealing?	Full	16	9.4
	¾ full	155	90.6
Do you know specific waste disposal buckets according to the level of their contamination?	Yes	167	97.7
	No	4	2.3

**Table (4):** Infection prevention practice questions for HCPs

Variables	Category	Frequency (N)	Percentage (%)
How often you wash your hands with proper detergent after contact with patient?	Always	68	39.8
	Sometimes	87	50.9
	Never	16	9.3
Do you use antiseptic hand rub to clean hands?	Yes	160	93.6
	No	11	6.4
How often do you use all personal protective equipment's as per standard to prevent infection?	Always	86	50.3
	Some times	85	49.7
When do you change chlorine solutions that used for instrumental processing?	Every 24 h	155	90.6
	After 2 days	16	9.4
How often do you use glove when you perform procedures that need wearing glove?	Always	142	83.0
	Some times	29	17.0
Have you ever exposed to blood or other body fluids of patients through contact or unprotected skin?	Yes	122	71.3
	No	49	28.7
What measure did you take if you are exposed to blood or fluids, needle stick injury?	Only taking Post exposure prophylaxis	19	11.1
	Only clean by alcohol	68	39.8
	Only washing with water	2	1.2
	Taking Post exposure prophylaxis and clean by alcohol	32	18.7
	Taking post exposure prophylaxis and washing with water	7	4.1
	Clean by alcohol and washing with water	14	8.2
	All action taken	29	17.0
Did you practice high-level disinfection where sterilization is not applicable?	Yes	124	72.5
	No	47	27.5
What is your facility sterilization technique?	Boiling	19	11.1
	steam sterilization	152	88.9

**Table (5):** Bivariate and multivariate logistic regression of factors associated with knowledge of HCPs towards infection prevention

Characteristics		Knowledge status		COR (95%CI)	AOR (95%CI)
		Adequate	Inadequate		
Sex	Male	80(67.2)	39(32.8)	0.55(0.25–1.18)	1.03(0.34–3.09)
	Female	41(78.8)	11(21.2)	1	1
Educational status	Diploma	65(63.7)	37(37.3)	1	1
	Degree	53(80.3)	13(19.7)	2.47(1.17–5.20)	1.05(0.32–3.44)
Work experience	< 5 Years	75(65.7)	39(34.3)	1	1
	>= 5 years	46(80.7)	11(19.3)	0.46(0.21–0.98)	1.52(1.13–4.51) *
IP Guideline	Yes	100(80.6)	24(19.4)	5.16(2.49–10.68)	3.65(1.26–10.54) *
	No	21(44.7)	26(55.3)	1	1
IP Training	Yes	32(42.1)	26(24.8)	17.64(6.87–45.33)	2.19(1.01–4.75)*
	No	44(57.9)	79(75.2)	1	1
Currently working unit	Outpatient department	30(32.2)	21(26.9)	1	
	Emergency and Triage	6(6.5)	16(20.5)	1.25(0.53–2.04)	0.25(0.13–1.54)
	Maternity unit	23(24.7)	10(12.8)	1.31(1.08–3.38)	1.67(1.38–5.23)*
	Inpatient clinic	8(8.6)	5(6.4)	0.78(0.25–2.81)	1.38(0.48–2.51)
	Laboratory	15(16.1)	14(17.9)	1.46(1.13–3.43)	2.56(1.26–4.13)*
	Pharmacy	6(6.5)	9(11.5)	0.84(0.39–3.03)	0.54(0.17–1.57)
	Under-five clinic	5(5.4)	3(3.8)	0.91(0.32–1.84)	0.87(0.57–3.47)

IP infection prevention, COR crude odds ratio, AOR adjusted odds ratio; \* = significantly associated at P < 0.05

**Table (6):** Bi-variable and multivariable logistic regression of factors associated with infection prevention practice of HCPs

Characteristics		Infection prevention practice status		COR 95% CI	AOR 95% CI
		Safe	Unsafe		
Sex	Male	80(67.2)	39(32.8)	0.55(0.26–1.19)	1.21(0.52–2.80)
	Female	41(78.8)	11(21.2)	1	1

Characteristics		Infection prevention practice status		COR 95% CI	AOR 95% CI
		Safe	Unsafe		
		8)			
Educational status	Degree	53(80.3)	13(19.7)	2.47(1.17–5.20)	0.78(0.32–1.91)
	Diploma	65(63.7)	37(37.3)	1	1
Work experience	< 5 Years	75(65.7)	39(34.3)	0.46(0.21–0.99)	0.89(0.42–1.913)
	> = 5 years	46(80.7)	11(19.3)	1	1
Presence IP guideline	Yes	100(80.6)	24(19.4)	5.16(2.49–10.68)	0.95(0.83–4.55)
	No	21(44.7)	26(55.3)	1	1
Infection prevention training	Yes	114(82.6)	24(17.4)	17.64(6.87–45.33)	2.19(1.13–4.75) *
	No	7(21.2)	26(78.8)	1	1
Availability of continuous water supply	Yes	74(52.1)	14(48.3)	1	1
	No	68(47.9)	15(51.7)	0.86(0.34–0.95)	0.48(0.21–0.83) *
Currently working unit	Outpatient department	39(36.1)	12(22.6)	1	1
	Emergency and Triage	9(8.3)	13(24.5)	0.21(0.13–1.24)	0.25(0.13–1.54)
	Maternity unit	18(16.7)	5(9.4)	1.11(0.79–1.21)	1.67(0.89–3.61)
	Inpatient clinic	7(6.5)	6(11.3)	0.28(0.15–1.63)	0.68(0.34–1.97)
	Laboratory	22(20.4)	7(13.2)	0.97(0.53–2.76)	3.24(1.68–6.27) *
	Pharmacy	7(6.5)	8(15.1)	0.84(0.39–3.03)	0.54(0.17–1.57)
	Under-five clinic	6(5.6)	2(3.8)	0.47(0.21–1.35)	0.79(0.36–2.17)

\*= significantly associated at P-value < 0.05

## References

1. WHO. WHO Guidelines on Hand Hygiene in Health Care: a Summary [Internet]. Geneva: WHO; 2009. <http://www.who.int/gpsc/5may/tools/en/index.html>.
2. Taffurelli C, Sollami A, Camera C, Federa F, Grandi A, Marino M, et al. Healthcare associated infection: good practices, knowledge and the locus of control in healthcare professionals. Acta bio-medica : Atenei Parmensis. 2017; 88(3s):31–6.
3. Lacerda RA. Hospital infection and sue relationship with the evolution of health assistance practices. Sao Paulo: Atheneu; 2003.
4. Organization WH. Report on the burden of endemic health care-associated infection worldwide.

2011.

5. Jroundi I, Khoudri I, Azzouzi A, Zeggwagh AA, Benbrahim NF, Hassouni F, et al. Prevalence of hospital-acquired infection in a Moroccan university hospital. *Am J Infect Control*. 2007;35(6):412–6.
6. Ogwang M, Paramatti D, Molteni T, Ochola E, Okello TR, Ortiz Salgado JC, et al. Prevalence of hospital-associated infections can be decreased effectively in developing countries. *J Hosp Infect*. 2013;84(2):138–42.
7. Kallel H, Bahoul M, Ksibi H, Dammak H, Chelly H, Hamida CB, et al. Prevalence of hospital-acquired infection in a Tunisian hospital. *J Hosp Infect*. 2005; 59(4):343–7.
8. Yallew WW, Kumie A, Yehuala FM. Risk factors for hospital-acquired infections in teaching hospitals of Amhara regional state, Ethiopia: a matched-case control study. *PLoS One*. 2017;12(7):e0181145.
9. Alonso-Aguilar NM, Juarez-Enriquez SR, Castro-Escarpulli G, Rivera G, Bocanegra-Garcia V, Guo X, et al. Aetiology and significance of hospital-acquired infections in Mexico. *Clin Lab*. 2017;63(2):207–18.
10. Guzman-Herrador B, Molina CD, Allam MF, Navajas RF. Independent risk factors associated with hospital-acquired pneumonia in an adult ICU: 4-year prospective cohort study in a university reference hospital. *J Public Health (Oxford, England)*. 2016; 38(2):378–83.
11. Beggs C, Knibbs LD, Johnson GR, Morawska L. Environmental contamination and hospital-acquired infection: factors that are easily overlooked. *Indoor Air*. 2015; 25(5):462–74.
12. Rothe C, Schlaich C, ST. Healthcare-associated infections in sub-Saharan Africa. *J Hosp Infect*. 2013; 85:3–14.
13. Koutzavekiaris I, Vouloumanou EK, Gourni M, Rafailidis PI, Michalopoulos A, Falagas ME. Knowledge and practices regarding prevention of infections associated with central venous catheters: a survey of intensive care unit medical and nursing staff. *Am J Infect Control*. 2011; 39(7):542–7.
14. Brisibe S, Ordinioha B, Gbeneolol PK. Knowledge, attitude, and infection control practices of two tertiary hospitals in port-Harcourt, Nigeria. *Niger J Clin Pract*. 2014;17(6):691–5.
15. Adegboye MB, Zakari S, Ahmed BA, Olufemi GH. Knowledge, awareness and practice of infection control by health care workers in the intensive care units of a tertiary hospital in Nigeria. *Afr Health Sci*. 2018; 18(1):72–8.
16. Deress T, Hassen F, Adane K, Tsegaye A. Assessment of knowledge, attitude, and practice about biomedical waste management and associated factors among the healthcare professionals at Debre Markos town healthcare facilities, Northwest Ethiopia. *J Environ Public Health*. 2018;2018:7672981.
17. Desta M, Ayenew T, Sitotaw N, Tegegne N, Dires M, Getie M. Knowledge, practice and associated factors of infection prevention among healthcare workers in Debre Markos referral hospital, Northwest Ethiopia. *BMC Health Serv Res*. 2018;18(1):465.
18. Geberemariam BS, Donka GM, Wordofa B. Assessment of knowledge and practices of healthcare workers towards infection prevention and associated factors in healthcare facilities of West Arsi District, Southeast Ethiopia: a facility-based cross-sectional study. *Arch Public Health*. 2018; 76:69.
19. Abd Elaziz KM, Bakr IM. Assessment of knowledge, attitude and practice of hand washing among health care workers in Ain Shams University hospitals in Cairo. *J Prev Med Hgiene*. 2009; 50(1):19–25.
20. Engelbrecht M, Janse van Rensburg A, Kigozi G, van Rensburg HD. Factors associated with good TB infection control practices among primary healthcare workers in the Free State Province, South Africa. *BMC Infect Dis*. 2016;16(1):633.
21. Bekele T, Gebremariam A, Kaso M, Ahmed K. Factors associated with occupational needle stick and sharps injuries among hospital healthcare Workers in Bale Zone, Southeast Ethiopia. *PLoS One*. 2015;10(10):e0140382.
22. Temesgen C, Demissie M. Knowledge and practice of tuberculosis infection control among health professionals in Northwest Ethiopia; 2011. *BMC Health Serv Res*. 2014;14:593.
23. Woldegioris T, Bantie G, Getachew H. Nurses' knowledge and practice regarding prevention of surgical site infection in Bahir Dar, Northwest Ethiopia. *Surg Infect*. 2019;20(1):71–7.
24. Alemayehu R, Ahmed K, OS. Assessment of knowledge and practice on infection prevention among health Care Workers at Dessie Referral Hospital, Amhara region, south Wollo zone, north East Ethiopia. *J Commun Med Health Educ*. 2016;6:4–8.

25. Gulilat K, GT. Assessment of knowledge, attitude and practice of health care workers on infection prevention in health institution Bahir Dar city administration. *Sci J Public Health*. 2014;2(5):384–93.
26. Biniyam S, Azeb G, Desta H, GT. Infection prevention practices and associated factors among healthcare workers in governmental healthcare facilities in Addis Ababa, Ethiopia. *Ethiop J Health Sci*. 2018;28(2):177–86.
27. Yakob E, Lamare T, AH. Knowledge, attitude and practice towards infection control measures among Mizan-Aman general hospital workers, south West Ethiopia. *Commun Med Health Educ*. 2015;5:5–9.
28. Gupta A, Kapil A, Lodha R, Sreenivas V. Knowledge, attitude and practice towards infection control among healthcare professionals. *Natl Med J India*. 2013;26(1):59–60.
29. Bedoya G, Dolinger A, Rogo K, Mwaura N, Wafula F, Coarasa J, et al. Observations of infection prevention and control practices in primary health care, Kenya. *Bull World Health Organ*. 2017;95(7):503–16.
30. Sahiledengle B, et al. Infection prevention practices and associated factors among healthcare Workers in Governmental Healthcare Facilities in Addis Ababa. *Ethiop J Health Sci*. 2018;28(2):2–8.
31. Weldu MG, Berhane H, Berhe N, Haile K, Sibhatu Y, Gidey T, et al. Magnitude and determinant factors of surgical site infection in Suhul hospital Tigray, northern Ethiopia: a cross-sectional study. *Surg Infect*. 2018;19(7):684–90.
32. Samuel R, Almedom AM, Hagos G, Albin S, Mutungi A. Promotion of handwashing as a measure of quality of care and prevention of hospital- acquired infections in Eritrea: the Keren study. *Afr Health Sci*. 2005;5(1):4–13.
33. World Health Organization. Guidelines on core components of infection prevention and control programs at the national and acute health care facility level. Geneva: WHO; 2016.
34. World Health Organization. [Guidelines on Core Components of Infection Prevention and Control Programmes at the National and Acute Health Care Facility Level]. World Health Organization. Country Office for Thailand; 2020.
35. Anwar M, Majeed A, Saleem RM, Manzoor F, Sharif S. Assessment of infection control practices in teaching hospitals of Quetta. *J Pakistan Med Assoc*. 2016;66(8):947–51.
36. Arinze-Onyia SU, Ndu AC, Aguwa EN, Modebe I, Nwamoh UN. Knowledge and practice of standard precautions by health-Care Workers in a Tertiary Health Institution in Enugu, Nigeria. *Niger J Clin Pract*. 2018;21(2):149–55.