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Factors Affecting Compliance With Infection Prevention And Control Standard Precautions Among Healthcare Workers In Makkah, Saudi Arabia

Abu Rabiah Abdulrahman Sulaiman A, Sultan Saeed Matrok Aldhahri, Raed Muhaysin Alobaid Alotaibi, Rasha Mubarak Alhassan Alhindi, Ahmad Saadi Alzahrani, Muath Saleh algathlan, Ahmed Abdulaziz Abdulrhman Bindraihim, Majid Mubarak Alosaimi, Yahya Ali Hassan Mubaraki, Khalaf Abdullah Matar Al-Otaibi, Hamdan Ayad Alotaibi, Abdullah Abdul Rahman Al Qasim

Abstract:

Background: Compliance with infection prevention and control standard precautions (IPCSPs) remains a major challenge in many countries including Tanzania. Lack of compliance exposes healthcare workers (HCWs) and patients to a high risk of developing healthcare-associated infections (HAIs) including antimicrobial-resistant microorganisms which can contribute to the spread of antimicrobial resistance (AMR). This study investigated compliance with IPCSPs and associated factors among HCWs in public healthcare facilities (HFs) in Makkah, Saudi Arabia between January and March 2022. Methods: A cross-sectional study was conducted involved 400 HCWs from difference healthcare facilities (HFs) including hospital, and health centres. The Compliance with Standard Precautions scale (CSPS) tool developed by WHO was used. Descriptive and modified Poisson regression analysis was done. A P-value of less than 0.05 indicated statistical significance. Results: Only 22.5% (90/400) of HCWs had high compliance (above 80%) to IPCSPs. The majority of HCWs reported highest compliance on discarding used needles/sharps into sharps containers (94%), the lowest IPCSPs compliance was for the correct handling of spills, taking a shower after extensive splashing and not re-using disposable masks, 8%, 28.5% and 34% respectively. Attending IPC training or an IPC seminar in the p[1]revious year (ARR¼2.97 [1.87e4.72] P<0.001), the number of years of work experience (ARR¼2.08[1.22e3.54] P¼0.007), and having experienced a needlestick injury (ARR¼0.62 [0.40 e0.95] P¼0.028), were identified as predictors of HCWs compliance with IPCSPs. Conclusion: The majority of HCWs in

1Public Health, Al Quwayiyah Hospital, Saudi Arabia.
2Public Health,Rawida General Hospital, Saudi Arabia.
3Health Inspector, Al-Dawami General Hospital, Saudi Arabia.
4Health administration specialist, Khalis Hospital, Saudi Arabia.
5Public health specialist, Preventive Medicine and Public Health Department, King Abdul Aziz Hospital in Makkah, Saudi Arabia.
6Public health specialist,Al-Shifa Hospital in Unayzah, Saudi Arabia.
7Specialist director of a primary health care centerAssistant Department of Public Health at the General Directorate of Health Affairs in the Riyadh Region, Saudi Arabia.
8Public health specialist, King Fahad health center, Saudi Arabia.
9Epidemiology technician, Al-Khawalif Health Center, Saudi Arabia.
10Epidemiology technician, Al-Bajadiya Hospital, Al-Thameriya Health Center, Saudi Arabia.
11Epidemiological observer, Shaqra General Hospital, Saudi Arabia.

Makkah region had low compliance with IPCSPs according to national standards. IPC training and the number of years of work experience predicted high compliance with IPCSPs. Capacity building initiatives, mentorship and supportive supervision should be emphasised for all HCWs in all HFs.

Keywords: *Standard precautions Infection prevention and control,Healthcare-associated infection Antimicrobial resistance*

Introduction:

Exposure to blood-borne pathogens in the 1970s led to the spread of hepatitis infections among HCWs in healthcare facilities (HFs). Infection prevention and control (IPC) initiatives have been introduced to protect healthcare workers (HCWs) especially from hepatitis B virus (HBV) and human immunodeficiency virus (HIV) infections [1]. Infection prevention and control standard precautions (IPCSPs) are a set of activities designed to prevent the transmission of organisms between patients/staff for the prevention of health care- associated infection (HAIs) [2].

Implementation of IPC is a universally relevant component of all healthcare systems and affects the health and safety of both people who use healthcare services and those who provide them [3]. Infection Control Africa Network (ICAN) has reported that attitude and behaviour practices by HCWs continue to fuel transmission of HAIs in Africa and Asia [1,4,5]. Emerging diseases like Ebola virus disease (EVD) and Coronavirus disease 2019 (COVID- 19) have underlined the need for strengthening IPC with the objective of having resilient healthcare systems, both at the national and facility level [6,7].

Compliance with IPCSPs has remained a challenge in Many countries as Saudi Arabia [1,8]. Poor IPC practices through contaminated hands of HCWs, equipment (e.g., stethoscopes, blood pressure machines, thermometers), healthcare interventions (such as surgery, diagnostic testing or invasive procedures) and via the environment lead to the exposure of patients to a high risk of developing HAIs mainly via direct contact [4,8,9]. National guidelines to enhance IPC practices for HCWs in HFs have been in existence since 2004. In July 2018 the guidelines were revised to include new updates from World Health Organization (WHO) [4].

HCWs are the key support for confronting an outbreak and hence high compliance to IPCSPs is crucial worldwide to maintain a robust IPC resource to help address outbreaks. [10]. This study aimed to explore factors associated with compliance with IPCSPs by HCWs in order to generate evidence and strategies that will help to address HCWs poor compliance with IPCSPs and to improve preparedness and response to future unexpected infectious disease outbreaks.

Methods

This was a cross-sectional study, which included 400 HCWs regardless of discipline, working in public healthcare facilities (HFs), health centres (which provide both outpatient and inpatient services including some surgical services), and hospitals in Makkah region from January to March 2022. The region had 1,026 HCWs, where 374 were working in hospitals, 212 in health centres and 440 in other sites. Sample size estimation was calculated using Kish Leslie's formula for cross sectional studies at 95% confidence interval and marginal error of 5% with consideration of 10% non- respondent rate by using median compliance to IPC principles 57% [8]. HCWs included from each HFs level were obtained by stratified sampling technique where the proportion to size was calculated and simple random sampling technique was done to each level by using electronic numbers. Medical students, interns or volunteers were excluded from the study.

Data collection tool and technique

The Compliance with Standard Precautions Scale (CSPS) tool developed by WHO was used [8]. The scale has 20 items which were responded using a four-point Likert scale (never, seldom, sometimes and always). Items 2, 4, 6, 15 and 20 were negatively stated. A score of 1 was given to an "always" response in positively worded statements and the "never" option in negatively worded statements, while 0 for the other responses, giving a total possible range score of 0e20 and was expressed in terms of percentages.

Dependent variable was compliance with IPCSPs which was dichotomous. A compliance score of 80% and above was categorized as high compliance and a compliance score of below 80% as low compliance. This is in accordance with Tanzania national guidelines for the recognition of implementation status of quality improvement initiatives in HFs including IPC improvement initiatives, that HCWs compliance rate of at least 80% is considered the desired level of compliance [11]. Compliance to IPCSPs examined adherence to personal protective equipment (PPE), disposal of sharps and waste products, decontamination and prevention of cross-infection between patients by observational methods. Social demographic variables and duration of work experience was done by self- reporting and information, for example, motivation was investigated by demonstrating HCWs had obtained a certificate of appreciation or other incentives such as competition in performing IPC interventions. Supportive supervision (SS) was investigated by recording if HCWs had received on job mentorship by supervisors from the same HFs or from external HFs.

Data management and analysis

Data were analysed in Stata version 15.0. Frequency distribution was compared using the Chi-square test entered in to bivariate modified Poisson regression model as outcome for this study was more than 15%. Factors included in the model were, profession, level of HF, working years' experience, IPC training in the previous year, needlestick injury (NSI) experience, blood/body fluid splash, hepatitis B vaccination status and IPCSS. Variables with P-value < 0.2 in bivariate modified Poisson regression analysis were added to multivariate modified Poisson regression model using forward selection. The model used to identify the compliance of to IPCSPs at P-value < 0.05

Ethical approval

Study was approved. Informed consent was obtained from study participant and form signed after agreeing to participate to the study. Confidentiality of study subjects was ensured.

Results

Demographic characteristics of the study respondents

Table I shows the demographic characteristics of the respondents. The total number of respondents was 400 (96% response rate). Respondents had a median age of 32 years with interquartile range (IQR) of 10 (29, 39). The majority of the respondents were: females (64.0%), nurses (38.5%), diploma level (35.3%), from hospital level HF (37.5%), and working in an outpatient department (40.5%).

Variable	Frequency Percent (%) (N¼400)
Age	

21 to 30	146	36.5
31 to 40	163	40.8
41 and above	91	22.7
Sex		
Female	256	64.0
Male	144	36.0
Professions		
Clinicians	110	27.5
Nurses	154	38.5
Medical Attendants	92	23.0
Others	44	11.0
Education level		
Degree	41	10.3
Diploma	141	35.3
Certificates	134	33.5
Secondary	55	13.7
Primary	29	7.2
Healthcare Facility level		
Hospital	150	37.5
Health centre	109	27.3
Dispensary	141	35.2
Working department		
Outpatient dept.	184	46.0
Reproductive and child health	57	14.3
Labour ward	55	13.7
Medical ward	29	7.2
Surgical ward	17	4.2
Paediatric ward	14	3.5
Other	44	11.0

Table II shows the respondents working experience where majority had been working in healthcare service delivery in less than 6 years (42.3%). In addition, majority of HCWs 46.3% and 71.3% had experienced NSI and blood/body fluid splash respectively, while 67.5% had not been vaccinated against hepatitis B. On IPC experiences, 79.3%, 79.3% and 40.8% had not received IPC training, did not receive any motivation on IPC initiatives in their working unit, and did not attend any IPC meeting at their working unit for the past one year of working respectively. 47.0% did not receive any IPC SS for the past one year.

Variable (N¼400)	Frequency	Percent (%)
Working experience (years)		
Less than 6	169	42.3
6 to 10	146	36.5
11 to 15	27	6.7
16 and above	58	14.5
Experience of needlestick injury		
Yes	185	46.3

No	215	53.7
Experience of blood/body fluid exposure		
Yes	285	71.3
No	115	28.7
Hepatitis B vaccination		
Yes	130	32.5
No	270	67.5
IPC training < 1 year		
None	317	79.3
Once	69	17.2
Two and above	14	3.5
Motivation		
No motivation	322	80.5
Annually	25	6.3
Quarterly	25	6.2
Monthly	28	7.0
IPC meetings attended		
Never	163	40.7
Monthly	91	22.7
Rarely	74	18.5
Weekly	32	8.0
Quarterly	31	7.8
Annually	9	2.3
Supportive supervision (SS) given		
No supervision	188	47.0
Annually	27	6.7
Quarterly	185	46.2

The overall average compliance of the HCWs to IPCSPs in Makkah Region was 66% where only 22.5% HCWs had high compliance to IPCSPs of greater than 80%. The majority HCWs (94%) reported the highest compliance with proper disposal of used sharp items into sharps boxes, while only 8% HCWs were correctly handling spills of blood/body fluid on surfaces by cleaning first. HCWs reported suboptimal compliances to the following IPCSPs: 71.5% did not shower after extensive splashing, 66% re-used disposable masks in working areas, 60.0% disposed of sharps boxes while full, and 26.5% recapped needles. For hand hygiene practices, 24.0% of HCWs did not wash their hands between each patient contact, while 41.5% did not use alcohol hand rub as an alternative when hands are not visibly soiled, and 47.0% used only water for hand washing (Table III).

SP No.	IPC standard precaution	Compliance (N¼400)	Percentage (%)
5	I put used sharp articles into sharps boxes	376	94.0
19	I wear gloves to decontaminate used equipment with visible soils	373	93.0
9	I cover my wound(s) or lesion(s) with waterproof dressing before patient contacts	362	90.5
10	I wear gloves when I am exposed to body	361	90.0

	fluids, blood products, and any excretion of patients		
17	Waste contaminated with blood, body fluids, secretion, and excretion are placed in red plastic bags irrespective of patient's infective status	353	88.0
18	I decontaminate surfaces and equipment after use	350	87.5
12	I decontaminate my hands immediately after removal of gloves	331	83
11	I change gloves between each patient contact	319	80
16	I wear a gown or apron when exposed to blood, body fluids, or any patient excretions	309	77.0
1	I wash my hands between patient contacts	303	76.0
4	I recap used needles after giving an injection*	292	73.5
14	My mouth and nose are covered when I wear a mask	293	73.0
7	I remove PPE in a designated area	256	64.0
2	I only use water for hand washing*	213	53.0
13	I wear a surgical mask alone or in combination with goggles, face shield, and apron whenever there is a possibility of a splash or splatter	184	46.0
3	I use alcohol hand rubs as an alternative if my hands are not visibly soiled	166	41.5
6	The sharps box is only disposed when it is full*	161	40.0
15	I reuse surgical mask or disposable PPE*	137	34.0
8	I take a shower in case of extensive splashing even after I have put on PPE	114	28.5
20	I clean up spillage of blood or other body fluid immediately with disinfectants*	32	8.0
	Overall mean compliance		66.0
	High compliance > 80%		22.5
	Low compliance <80%		77.5

The findings of this study showed statistically significant differences between respondents working in dispensaries, health centres and hospitals in the compliance with IPCSPs (P¼0.008). A high proportion (33.0%) of HCWs at health centres had a high compliance with IPCSPs compared to those working at hospitals and dispensaries. Furthermore, compliance with IPCSPs was found to be statistically significant in the number of years of working experience (P¼0.026); Working experience of 11e15 years had the highest proportion (44.4%) of high compliance with IPC SPs compared to those with less than 6 years of working experience (18.3%). Additionally, the findings observed a statistically significant difference between

respondents who had received IPC training in previous 1 year (P<0.001). Respondents who had received two or more IPC training sessions in the previous year had a higher proportion (64.3%) of high compliance with IPCSP compare to those with none. Nevertheless, the findings showed statistically significant difference in NSI exposures (P¼0.005) whereby those with no exposure to NSI had high proportion (27.9%) of high compliance with IPCSPs compared to those with NSI exposure.

Furthermore, there was a statistically significant difference between respondents who received IPC SS at their working unit (P¼0.004). Respondents who had at least one IPC SS per year had higher proportion (44.4%) of high compliance with IPCSPs and those who did not receive any IPC SS at their working unit (17.0%). Lastly, findings showed no statistically significant difference in age, sex, professional disciplines and IPC motivation in compliance with IPCSPs (Table IV).

Table IV; HCWs who were clinicians were 0.61 times less likely to comply with IPCSPs at a high level compared to nurses. This was statistically significant. Medical attendants were 0.87 times less likely to comply with IPCSPs at high level compared to nurses though it was not statistically significant and other profession were 0.84 times less likely to comply with IPCSPs to high level compare to nurses but was not statistically significant. HCWs who worked in health centres were 1.86 times more likely to comply with IPCSPs at high level compared to those working at hospitals and it was statistically significant while HCWs working at dispensaries were 1.23 times less higher likely to comply with IPCSPs compare to those working at hospitals though this was not statistically significant.

Likewise, HCWs who had working experience of 11e15 years were two times more likely to comply with IPCSPs at high level compared to those who worked below six years and it was statistically significant. Those who worked 16 years and above were 1.32 times more likely to comply with IPCSPs at higher level compared to those who worked for less than 6 years but it was not statistically significant. Lastly, those with working

experience of 6e10 years were 1.29 times more likely to be compliant with IPCSPs at a high level though it was not statistically significant.

HCWs who had received one training session on IPC in a previous year were 1.88 times more likely to comply with IPCSPs at a high level compared to those who had no training in a previous year (P¼0.002). While those who had two or more training sessions on IPC in the previous year were 3 times more likely to comply with IPCSPs at a high level compared to those with no training in a previous one year (P<0.001). However, HCWs who had exposure to NSI were 0.62 times less likely to comply with IPCSPs at a higher level compared to those with no history of exposure (P¼0.028). HCWs who received one SS per year on IPC were two times more likely to comply with IPCSPs at a high level compared to those who did not receive any SS (APR¼2.09 [1.25e3.50] P¼0.005). There was no significant association between other factors such as blood/body fluid exposure history, hepatitis B vaccination status and compliance with IPCSPs.

	Compliance		Bivariate		Multivariate	
	Low value	High	P Value	CPR (95%CI)		P
		APR (95%CI)		P valu		
Profession						
Nurses	112 (72.7)	42 (27.3)	0.085	Ref		Ref
Clinicians	94 (85.4)	16 (14.6)	0.53 (0.32e0.90)	0.018	0.61 (0.37e0.99)	0.049

Medical attendants	72 (78.3)	20 (21.7)	0.80 (0.50e1.27)		0.340	0.87 (0.55e1.38)	0.561
Other professions	32 (72.7)	12 (27.3)	1 (0.58e1.73)		1.000	0.84 (0.51e1.40)	0.509
Healthcare Facility level							
Hospital	121 (80.7)	29 (19.3)	0.008	Ref		Ref	
Health centre	73 (67.0)	36 (33.0)		1.71 (1.12e2.61)	0.013	1.86 (1.23e2.80)	0.003
Dispensary	116 (82.3)	25 (17.7)		0.92 (0.51e1.49)	0.726	1.23 (0.73e2.04)	0.430
Years of work experience							
less than 6	138 (81.7)	31 (18.3)	0.026	Ref		Ref	
6 to 10	113 (77.4)	33 (22.6)		1.23 (0.80e1.91)	0.350	1.29 (0.85e1.95)	0.240
11 to 15	15 (55.6)	12 (44.4)		2.42 (1.43e4.11)	0.001	2.08 (1.22e3.54)	0.007
16 and above	44 (75.9)	14 (24.1)		1.32 (0.75e2.30)	0.350	1.32 (0.80e2.18)	0.279
IPC training in previous year							
None	263 (83.0)	54 (17.0)	0.0001	Ref		Ref	
Once	42 (60.9)	27 (39.1)		2.30 (1.57e3.37)	<0.001	1.88 (1.26e2.82)	0.002
two and above	5 (35.7)	9 (64.3)		3.77 (2.38e5.98)	<0.001	2.97 (1.87e4.72)	<0.001
Needlestick injury							
No	155 (72.1)	60 (27.9)	0.005	Ref		Ref	
Yes	155 (83.8)	30 (16.2)		0.58 (0.39e0.86)	0.007	0.62 (0.40e0.95)	0.028
Blood/body fluid splash							
Yes	226 (79.3)	59 (20.7)	0.175	Ref		Ref	
No	84 (73.0)	31 (27.0)		1.30 (0.89e1.90)	0.170	1.02 (0.68e1.53)	0.910
Hepatitis B Vaccination status							
No	217 (80.4)	53 (19.6)	0.048	Ref		Ref	
Yes	93 (71.5)	37 (28.5)		1.45 (1.01e2.09)	0.046	1.23 (0.84e1.79)	0.274
IPC Supportive supervision							
Never	156 (83.0)	32 (17.0)	0.004	Ref		Ref	
Annually	15 (55.6)	12 (44.4)		2.61 (1.54e4.42)	<0.001	2.09 (1.25e3.51)	0.005
Quarterly	139	46 (24.9)		1.46	0.660	1.13	0.220

	(75.1)			(0.98e2.19)		(0.86e1.87)	

Discussion

This study demonstrated low compliance with IPCSPs among HCWs at Makkah region as per national standards. In addition, the study showed that the majority of HCWs do not always wear surgical masks, eye protection, waterproof aprons, and that they tend to re-use disposable masks. Furthermore, the study found being a nurse, having received IPC training, had a longer duration of work experience, having received IPC supportive supervision, the healthcare facility level, lack of NSI exposure as associated factors with high compliance with IPCSPs. Low compliance with IPCSPs presents a risk for patient safety and HCWs safety as well as reducing the quality of healthcare services in general.

The study identified that few HCWs always wear surgical masks, do not reuse disposable surgical masks and one-third of HCWs still recap needles. This low compliance with IPCSPs findings are consistent with other studies which showed that the majority of HCWs were non-compliant [12,13]. These poor practices are due to carelessness, attitude, lack of motivation, inadequate knowledge on IPCSPs among HCWs, and inadequate equipment and supplies in HFs [14e17]. The findings showed that hand hygiene practice between patients was high compared with findings from a study done previously in Tanzania which reported low hand hygiene compliance [5]. The improvement in this current study could be due to the ongoing high profile of IPC and the distribution of hand washing facilities as part of the COVID-19 pandemic response interventions which include hand hygiene.

This study reported that nurses were more likely to comply with IPCSPs at a high level compared to other clinicians, medical attendants and other healthcare professions. This is consistent with a study done in Jordan which showed that nurses' scores for compliance were higher compared to other clinicians [3]. This could be due to presence of IPC clinical education in their curriculum at nursing school compared to other healthcare professions in which IPC is not included. This seems to have a positive effect on nurses' compliance with IPCSPs at work.

Furthermore, HFs level was associated with compliance with IPCSPs at a high level. Interestingly, HCWs working at health centers are more likely to comply with IPCSPs at high level compared to those working at hospitals. This finding correlated with another study done previously in Tanzania, which reported HFs from higher service levels (Hospitals) had a relatively higher proportion of IPC scores at baseline. However, during reassessment, lower-level HFs (Health Centers and Dispensaries) in Tanzania had higher improvements in scores compared with those from higher service level HFs to the extent that there was no statistically significant difference between low and high level facilities after the intervention [18]. This could be due to training, supportive supervision (SS) and assessment modalities which were taking place in all facility levels.

The number of years of work experience was associated with compliance to IPCSPs. HCWs who had been at work for 11e15 years were more likely to comply with IPCSPs compared with those who had worked for less than six years. This is consistent with a study done in Jordan which reported length of clinical experience had positive impact on compliance with IPCSPs [3]. This result may be because of experience obtained from many years' training, mentorship and supportive super- vision (SS) on IPC at work during employment. The number of IPC training sessions was also associated with compliance with IPCSPs at a high level. HCWs who had received at least two training sessions were more likely to comply with IPCSPs compared to those who received one training session or those who did not receive any training in the previous year. This is supported by multiple studies which reported IPC trainings as the factor that most affected IPC compliance [19e21]. This can be explained by the fact that IPC

training provides current evidence updates on IPC for HCWs and patient safety from lessons learnt from outbreaks that happened including Ebola and COVID-19 and therefore contributing to higher compliance with IPCSPs.

SS was another factor associated with high compliance with IPCSPs. HCWs who did not receive any SS on IPC in a year had low compliance with IPCSPs compared to those who received at least one episode of SS in a year. This finding is consistent with a study done in Liberia which revealed the improvement of IPC compliance when comparing before and after SS [22]. This could be due to SS providing onsite coaching, self-assessment and feedback. The WHO recommended that HCWs are pro- vided with SS in IPC in order to improve their skills, raise job motivation and satisfaction, and to improve performance through technical advice provided on the spot [23].

HCWs with no history of NSI exposure had higher compliance to IPCSPs compared to those exposed to NSI. This finding is similar to study done in China which showed exposure to NSI significant contributed to poor compliance to IPCSPs [24]. This could be explained by inappropriate behaviour and poor adherence to standard operating procedures for the correct handling sharps and for safe injection which may result in NSI [23].

There are some limitations in this study which should be acknowledged. These include Hawthorne effect whereby HCWs changed their health care delivery behaviours while being observed for IPCSPs compliance. However, the study method- ology was likely to be more reliable than self-reported behaviour. In addition, because it involved observation over a period of time, the HCWs tended to demonstrate their normal practice. Another limitation is the possible effect of the availability of infrastructure and supplies to HFs on compliance with IPCSPs as the study did not investigate these issues as factors for compliance with IPCSPs. Lastly, the compliance tool used in the study was originally developed and validated to assess self-reported compliance with standard precautions and not as an observation check list tool for compliance with standard precautions. However, we believe that the observation was the best way to ensure real compliance of HCWs. It has been reported in one study that there is a difference between what is reported by HCWs and actual findings [25]. As the study was mainly based on HCWs factors rather than healthcare system factors, we recommend other studies to be conducted on healthcare system factors affecting the compliance with IPCSPs among HCWs.

Conclusion and recommendations:

The majority of HCWs in Makkah region had low compliance to IPCSPs. This compliance level is below national level standards to guarantee safety of HCWs and patients especially in this era of emerging and re-emerging infections including the ongoing COVID-19 pandemic. Being a nurse, IPC training, the number of years of work experience, IPC supportive super- vision, working in a health centre, lack of NSI exposure were all associated with high compliance to IPCSPs. Based on these findings, it is recommended that all HCWs regardless of discipline in Makkah region should comply with all IPCSPs including hand hygiene, wearing appropriate PPEs, proper waste disposal and decontamination of surfaces. Also, HCWs should be aware of and read available national IPC guidelines, standards and standard operating procedures in order to gain more knowledge and skills in IPC. Furthermore, HCWs should engage with facility and working unit IPC meetings and on the job training to expand knowledge and performance. Healthcare management teams from regional, council and facility level should encourage capacity building in IPC through workshops and cascade training to all HCWs; should intensify IPC SS in different working units to help HCWs improve IPCSPs compliance and should ensure patient and HCWs safety and enhance the quality of healthcare services.

The Ministry of Health (MoH) is recommended to invest in more resources and research in IPC implementation and HAIs surveillance. This will enable the MoH to observe any improvements from interventions which are conducted nationally by building HCW capacity and providing evidence- based information for decision making. Furthermore, there is a need for additional resources for the continuity and intensification of SS and refresher training for all HCWs. Lastly, consideration should be put on inclusion of IPC in curriculum for all health-care disciplines where IPC is not currently part of the curriculum to promote effective and high quality healthcare services especially in this era of emerging and reemerging diseases.

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