Healthcare workers' SARS-CoV-2 infection prevention and control practices during COVID-19 outbreak in a southwest state of Nigeria

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ABSTRACT:

Objective: Healthcare workers are at risk of exposure to the SARS-CoV-2 virus which causes COVID-19 disease since they are the first line contact with patients in the healthcare sector. Thus, their infection prevention and control (IPC) practices have critical implications in limiting hospital transmission of the disease during the COVID-19 pandemic. In this study, we assessed the IPC practices by healthcare workers during the COVID-19 outbreak in the southwestern state of Nigeria.

Materials and methods: A cross-sectional study was conducted among healthcare workers in two local government areas (LGAs) in Ondo State. Data were collected through interviewers' administered questionnaire to the respondents, capturing their socio-demographic characteristics, knowledge of IPC, attitude, and practices toward the SARS-CoV-2 virus prevention. The data were collected between November and December 2020, then scrutinized for completeness and analysis using SPSS (version 18.0; Chicago, IL, USA). The 95% confident interval (CI) and the computed p-value were used to determine the relationship between dependent and independent variables. Hence, the *p*-value of < 0.05 was considered statistically significant.

Results: The interview was carried out on 293 healthcare workers, among which most of the respondents 235 (80.2%) were female, 80 (27.3%) were within the age group of 40-49 years (Mean ± Standard deviation: 40.2 ± 11.8), and 227 (77.5%) of the respondents were married. More than half (172, 58.7%) of the respondents were community health workers. The result showed that most of the respondents, 248 (84.6%) have good knowledge of IPC while more than half of the respondents, 195 (66.6%) have a good attitude towards IPC, and 80 (27.3%) had good IPC practices towards SARS-CoV-2 virus prevention. Significantly, the odds of having good IPC practice increased among the respondents who have been trained on IPC compared to those who have not been trained (AOR= 3.5; 95% CI= 1.5-8.3).

Conclusions: The study revealed good IPC knowledge and a high attitude towards SARS-CoV-2 virus prevention and control. However, the IPC practices towards SARS-CoV-2 virus prevention and control were suboptimal. Hence, the study recommends training and re-training of healthcare workers and in addition adequate supply of personal protection equipment (PPE)/IPC commodities and regular supportive supervision to ensure that IPC knowledge translates into practice among healthcare workers in the fight against SARS-CoV-2 virus infection.

Keywords: Healthcare worker, SARS-CoV-2 virus infection, Infection prevention and control practice, Nigeria.

— *Abbreviations:* AOR: Adjusted odds ratio; CI: Confidence interval; COR: Crude odds ratio; COVID-19: Coronavirus Disease 2019; HCW: Healthcare Workers; HWs; IPC: Infection prevention AND control; PPE: Personal Protective Equipment; LGA: Local Government Areas, NCDC: Nigeria Center for Disease Control; SMoH: State Ministry of Health.

INTRODUCTION

COVID-19 is a respiratory infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) that has spread throughout the world since the first localized outbreak in China in December 2019 with a resultant considerable impact on global morbidity and mortality[1-4]. Currently, Nigeria is ranked among the top countries within the African region due to the ongoing transmission of SARS-CoV-2 infection with health care workers representing a good proportion of these cases[5,6].

Between March 2020 and December 2021, in the southwest, Ondo State, Nigeria, a total of 4,591 confirmed cases of SARS-CoV-2 infection were reported as 13.4% of these infections were recorded among healthcare workers within the health care sector, and the cases have been on the rise with hospital transmission among healthcare workers ongoing[4].

Hospital transmission of SARS-CoV-2 infection has been a major contributor to the spread of SARS-CoV-2 during the pandemic[7]. Health care workers are present at the frontline in the fight against the highly infectious SARS-CoV-2 hence, at a high risk of infecting themselves and others. Possibly by breathing in droplets from infected patients and touching contaminated surfaces due to their significant exposure to patients daily and increased workload during the pandemic[8-14].

The federal government and the Nigeria Center for Disease Control (NCDC) have published the SARS-CoV-2 Infection Prevention and Control (IPC) protocol and disseminated it to healthcare workers to reduce transmission of the infections during the pandemic[15]. This protocol guides healthcare workers on how and when to use personal protective equipment (PPE) like masks, gloves, and gowns, separating patients with respiratory infections, and stricter cleaning routines[15]. Infection prevention and control (IPC) practices in the healthcare sector are documented as the major factors controlling potential outbreaks and transmission of diseases, especially within the health care settings[8]. Therefore, assessing and understanding healthcare workers' IPC practices during the ongoing SARS-CoV-2 outbreak will further identify IPC gaps and enable public health authorities to implement interventions that will limit the spread of the SARS-CoV-2 infection among healthcare workers.

MATERIALS AND METHODS

Study Area

Nigeria is the most populous country in Africa, with an estimated population of over 160 million[16] and a growth rate of 3.8% per annum. The country has six geopolit-ical zones and is divided into 36 states and the federal capital territory, and further divided into 774 LGAs or districts and 8812 administrative wards[17]. Ondo State is one of the 36 states in the Federal Republic of Nigeria situated in the southwestern geopolitical zone of the country[18]. The state has 18 LGAs with three senatorial districts, including Ondo North, Central, and South with 2021 projected populations of about 5,361,003 based on the 2006 population *census*. The state has about 800 primary health facilities, 18 general hospitals, 6 tertiary health facilities, and several private health facilities located across all LGAs in the state[19].

Nosocomial transmission of several diseases among health care workers during outbreaks has previously been reported in Ondo State[20], for instance, during the outbreak of Lassa fever in 2019. In the study of Saleh et al[20] on exposure incidents and outcomes of Lassa fever virus infection among healthcare workers in Nigeria, a total of 19 confirmed Lassa fever cases were reported, of which 26.3% was recorded in Ondo State. Most of the nosocomial infections occurred among health care workers in public health facilities[20]. Similarly, during the preliminary phase of the SARS-CoV-2 outbreak in Ondo State (April to August 2020), Isere et al[4] in their study, reported that about one third (30.7%) of the total confirmed cases of SARS-CoV-2 (1316) reported in the state were healthcare workers providing healthcare services in several health facilities across the state.

Study Design, Sample Size Estimation and Sampling Method

The research design of this study is a descriptive cross-sectional study of healthcare workers in all government-owned and private hospitals in the two LGAs in Ondo State. In this study, healthcare workers are defined as all paid and unpaid persons serving in healthcare settings and have the potential for direct or indirect exposure to patients or their infectious secretions and materials (e.g., doctors, nurses, medical laboratory scientists, maintenance staff, clinical trainees, volunteers, etc.)[21].

Study participants were selected using a multi-stage sampling technique. First, the list of all LGAs in the state was obtained by the state public health authorities with two LGAs (Akure South and Owo) randomly selected by balloting. Secondly, the list of all government and privately-owned hospitals was obtained from the district primary health care department from which the study participants were selected. The study population included clinical members of staff, namely medical doctors, nurses, midwives, Community Health Officers, Community Health Extension Workers, pharmacists, and medical laboratory technologists.

The study participants recruited were senior clinical staff who were full-time employees of the health facility for at least 6 months before November 2020 and who gave their consent to participate in the study. For each health facility visited during the study, a list of all senior clinical staff on the duty roster was obtained. Then, one senior clinical health care worker was selected randomly for balloting and interviewed using a semi-structured questionnaire.

To determine the sample size of the study, Fisher's formula[22] for estimating single proportions and estimation for minimum sample size was applied, and the estimated sample size was 189. Fisher's formula: n = Z^2P $(1 − P)/d^2$; where: n = sample size, Z = standard deviation for a 95% confidence level (Z = 1.96), and p = prevalence of the attribute which was obtained from Afemikhe et al[8] where 85.6% of health care workers had good IPC practice towards SARS-CoV-2 infection in Edo state, Nigeria; while d = acceptable difference (if 5%, d = 0.05); q = 1 − p.

Data Collection and Analysis

Data were collected using an interviewer-administered questionnaire that captured information on socio-demographic variables, knowledge, attitude, and practices on IPC towards SARS-CoV-2 infection prevention in the healthcare setting. Research assistants were recruited, trained, and thereafter deployed to the field.

Data were analyzed using SPSS version 18.0 (Chicago, IL, USA) and were summarized using mean and standard deviation for continuous variables, frequencies, and percentages for categorical variables. Knowledge of IPC score was computed with "+1" assigned for correct response and "0" assigned for incorrect response. These were graded as good or poor knowledge, using their mean score as the cut-off point. To evaluate the attitude of the health workers towards IPC, 8 questions were asked. For attitude questions directed in a positive direction, 3 points were assigned to agree, 2 points to neutral and 1 point to disagree, and vice versa for questions directed in the negative direction to give a total attitude score of 24 points. Respondents with scores below 12, 12-20, and above 20 were categorized as having a low, moderate, and high attitude towards SARS-CoV-2 infection IPC, respectively[23]. The following points were assigned to a Likert scale and used to grade participants' responses to the IPC practice questions; a total of 3 points was assigned to "always," 2 points to "sometimes," 1 point to "rarely," and no point to "never;" given a maximum of 3 points per question for a participant. A maximum of 21 points was assigned to the 7-itemized IPC questions. Respondents with an average score of 11 and below were categorized as poor practices, while those with scores between 11 and 15, and scores above 15 were categorized as fair and good practices respectively. In the bivariate analysis, respondents with scores of 15 and below were re-categorized as poor practices, while those with scores above 15 remained as good practices of IPC. Variables in the bivariate test with a p-value of <0.2 were included in the multivariate model, with a level of significance set at p-value<0.05.

RESULTS

Socio-demographic Characteristics of Respondents in Ondo State

A total of 293 healthcare workers were interviewed. More than half of 235 (80.2%) of the respondents were female, 80 (27.3%) were within the age group 40-49 years (Mean ± Standard deviation: 40.2 ± 11.8), and 227 (77.5%) were married. More than half (172, 58.7%) of the respondents were community health workers while (283, 96.6%) of the respondents have completed tertiary level of education (Table 1).

Level of Knowledge of Infection Prevention and Control Among 293 Healthcare Workers in Ondo State, Nigeria

Table 2 shows the knowledge of respondents about Infection Prevention and Control (IPC). Most of the respondents (275, 93.8%) knew IPC as a measure to prevent and

Table 1. Sociodemographic characteristics of 293 healthcare workers in Ondo State, Nigeria.

	Frequency	Percentage (%)
Gender		
Male	58	19.8
Female	235	80.2
Age		
<30	78	26.6
30-39	63	21.5
40-49	80	27.3
50-59	57	19.5
≥60	15	5.1
Marital status		
Single	56	19.1
Married	227	77.5
Divorced/separated	1	0.3
Widowed	9	3.1
Qualification		
Community Health worker/ Officers/Health Assistants	172	58.7
Midwife	14	4.8
Nurse	50	17.0
Registered nurse and Midwife	10	3.4
Medical Officer	38	13.0
Laboratory Officer	9	3.1
Highest level of education		
Primary	3	1.0
Secondary	7	2.4
Tertiary	283	96.6
Years of working experience		
< 10 Years	153	52.2
10-20 years	68	23.2
>20 years	72	24.6
Level of health care		
Primary	198	67.6
Secondary	87	29.7
Tertiary	8	2.7
Type of health facility		
Public	208	71.0
Private	85	29.0

Table 2. Level of knowledge about Infection Prevention and Control among 293 healthcare workers in Ondo State, Nigeria.

	Frequency	Percentage (%)
Understanding the term Infection Prevention and Control		
Measures are taken to prevent and reduce the spread of infections	275	93.8
*Others	17	5.9
Don't know	1	0.3
Two importance of IPC in the delivery of health services		
Listed two importance of IPC	233	79.5
Listed one importance of IPC	48	16.4
Listed no importance of IPC	12	4.1
How medical waste should be best disposed		
Burn and bury	211	72.0
Incinerate	72	24.6
Do not know	10	3.4
Mention at least 5 common infections that can be transmitted through poor IPC		
The proportion that mentioned 5 infections	220	75.1
The proportion that mentioned 4 infections	48	16.4
The proportion that mentioned 3 infections	20	6.8
The proportion that mentioned less than 3 infections	5	1.7
When is it appropriate for hand washing (a proportion that said yes; multiple responses allowed)		
Before attending to each patient	274	93.5
After attending to each patient	277	94.5
Before and after attending to each patient	288	98.3
Before any surgical or medical procedure	278	94.9
After contact with dirty surfaces	287	98.0
After contact with body fluids	290	99.0
Knew hand rubs as other methods of hand hygiene aside from soap and water		
Yes	46	15.7
No	247	84.3
Mention at least 3 diseases required for mandatory isolation		
The proportion that listed at 3 diseases for mandatory isolation	207	70.6
The proportion that listed 2 diseases for mandatory isolation	72	24.6
The proportion that listed 1 disease for mandatory isolation	14	4.8

*Infection that affects the body structure

reduce the spread of diseases. More than two-thirds (233, 79.5%) of the respondents mentioned at least 3 importance of IPC, 220 (75.1%) mentioned 5 common infections that can be transmitted through poor IPC and 207 (70.6%) mentioned at least 3 diseases that require mandatory isolation. An assessment of the overall knowledge of the respondents showed that 248 (84.6%) had good knowledge, while 45 (15.4%) had fair/poor knowledge of IPC.

Attitude toward SARS-CoV-2 infection Prevention and Control Among 293 Healthcare Workers in Ondo State, Nigeria

In Table 3, 265 (90.4%) of the respondents disagreed that wearing gloves is a substitute for washing hands, 280 (95.6%) agreed to wear a surgical mask and other PPEs while attending to patients in the clinic is uncomfortable.

Table 3. Attitudes towards SARS-CoV-2 infection prevention and control among 293 healthcare workers in Ondo State, Nigeria.

	Agree: n (%)	Disagree: n (%)	Neutral: n (%)
Wearing gloves is a substitute for hand hygiene practice	26 (8.9)	265 (90.4)	2 (0.7)
Wearing a surgical mask and other PPEs while attending to patients in the clinic is uncomfortable	280 (95.6)	12 (4.1)	1 (0.3)
The spatial separation of 2 meters between patients in the clinic is difficult because of insufficient space	39 (13.3)	248 (84.6)	6 (2.0)
Using a surgical mask, goggles, face shield and other PPEs by health workers makes patients feel stigmatized	76 (25.9)	212 (72.4)	5 (1.7)
Changing gloves and washing hands between patients is not necessary	18 (6.1)	274 (93.5)	1 (0.3)
Health workers' work intensity affects their ability to adhere to general IPC protocol.	270 (92.2)	21 (7.2)	2 (0.7)
PPEs should be used by health workers only when provided by hospital management	49 (16.7)	244 (83.3)	0 (0.0)
Hospital management support such as supervision will encourage adherence to IPC protocol by health workers	278 (94.9)	14 (4.8)	1 (0.3)

Table 4. Availability of SARS-CoV-2 IPC guidelines and training experience on IPC among 293 healthcare workers in Ondo State, Nigeria.

	Frequency	Percentage (%)
Have either an electronic or hard copy of SARS-CoV-2 infection control guidelines		
Yes	255	87.0
No	38	13.0
Reasons for not having a copy of SARS-CoV-2 IPC guidelines (n=38)		
It was not provided	21	55.3
No access to it	2	5.3
Don't know	15	39.4
Ever read the copy of SARS-CoV-2 infection control guidelines available (=255)		
Yes	238	93.3
No	17	5.7
How often is the guideline followed (=238)		
Occasionally	8	3.4
Often	29	12.2
Always	200	84.0
Never	1	0.4
Ever been trained on IPC		
Yes	234	79.9
No	59	20.1
When were you last trained (n = 234)		
2017 and below	14	6.0
2018	22	9.4
2019	61	26.1
2020	137	58.5

Two hundred and forty-eight (84.6%) of the respondents disagreed that spatial separation among patients in the health facilities is difficult because of insufficient space, while 270 (92.2%) agreed that the work intensity affects their ability to fully apply infection prevention guidelines. Also, one-third of the respondents, 195 (66.6%) have a high attitude towards the IPC, while 93 (31.7%) and 5 (1.7%) have moderate and low attitudes, respectively.

Availability of SARS-CoV-2 IPC Guidelines and Training Experience on IPC Among 293 Healthcare Workers in Ondo State, Nigeria

Table 4 shows 255 (87%) of the respondents have either an electronic or hard copy of the SARS-CoV-2 infection prevention and control guidelines. Among the 38 (13%) without a guideline, 21 (55.3%) reported that it was not provided. A majority of 238 (93.3%) respondents with a copy of the SARS-CoV-2 IPC guidelines reported never reading it, while 200 (84%) reported always following the contents of the guidelines. About two-thirds (234, 79.9%) of the respondents have been trained on IPC, among whom 137 (58.5%) were trained in the year 2020.

Practices Towards SARS-CoV-2 Infection Prevention and Control Among 293 healthcare workers in Ondo State, Nigeria

As shown in Table 5, 268 (91.5%) of the respondents reported that they always wash their hands with soap and water before and after attending to patients. More than three-quarters (234, 79.9%) of the respondents reported that they always wear protective surgical masks. Two hundred and eighty-nine (98.6%) of the respondents reported that they always clean the ward/hospital, while 63 (21.5%) reported that they always screen and

Table 5. Practice towards SARS-CoV-2 Infection Prevention and Control among 293 healthcare workers in Ondo State, Nigeria.

	Always N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)
Wear hand gloves when attending to patients	268 (91.5)	23 (7.8)	2 (0.7)	0 (0.0)
Wash your hands with soap and water before and after every procedure	268 (91.5)	23 (7.8)	2 (0.7)	0 (0.0)
Wear surgical masks and goggles when attending to patients	234 (79.9)	38 (13.0)	20 (6.8)	1 (0.3)
Cleaning and disinfection of hospital wards/clinics	289 (98.6)	2 (0.7)	2 (0.7)	0 (0.0)
Dispose of used face masks, gloves and other medical waste using appropriate waste disposal bin	272 (92.8)	0 (0.0)	0 (0.0)	21 (7.2)
Provide patients who come to the hospital with a face mask	48 (16.4)	0 (0.0)	0 (0.0)	245 (83.6))
Screen and triage patients for SARS-CoV-2 infection and Isolate patients with symptoms in the isolation unit	63 (21.5)	0 (0.0)	0 (0.0)	230 (78.5)

triage patients. The overall level of practice of the IPC among respondents revealed that 80 (27.3%) had good, 207 (70.6%) had fair, and 6 (2%) had a poor level of IPC practice.

Factors Associated with SARS-CoV-2 IPC Practices Among 293 Healthcare Workers in Ondo State, Nigeria

Table 6 reveals that qualification and training on IPC significantly influenced the level of practice towards SARS-CoV-2 IPC among respondents. A high percentage of respondents that were medical officers (44.7%), laboratory officers (44.4%), and Nurse/Midwife (24.3%) had good practice towards SARS-CoV-2 IPC compared to community health workers/health attendants (23.8%) (*p* = 0.036). Significantly, the odds of having good practice of IPC increased 3 folds among respondents that were laboratory officers compared to those that were community health workers (AOR= 2.8; 95% CI= 1.3-5.9). Likewise, a higher proportion (31.2%) of respondents that have been trained on IPC had good SARS-CoV-2 IPC practice compared to those that have never received training (11.9%) (*p*= 0.003). The odds of

having good practice of SARS-CoV-2 IPC increased 4 folds among respondents that have been trained on IPC compared to those that have not been trained (AOR= 3.5; 95% CI= 1.5-8.3)

DISCUSSION

Most of the respondents in this study were healthcare workers in the primary health care cadre. This is consistent with Otu et al[20] and Fatiregun et al[24]. Otu et al[20] reported that Ondo State has over 800 primary health facilities including 18 general hospitals, 6 tertiary hospitals and more than 100 registered private hospitals. Also, the findings which revealed that 67.6% of the respondents were recruited from primary health care facilities further explain this outcome. Fatiregun et al[24] has reported a similar finding of 57.2% of the respondents being primary health care workers in their study among health care workers in the same state. Most of the respondents in the study area were females. This is consistent with a previous study conducted in the state by Fatiregun et al[24] who reported that 83.6% of the respondents were females. This is likely to reflect the differential roles of gender in the health profession[24]. Several of

Table 6. Factors associated with SARS-CoV-2 IPC practice among 293 healthcare workers in Ondo State, Nigeria.

Variables	Infection prevention and control practices		Total	*p*-value	Unadjusted odds ratio	Adjusted odds ratio (lower and upper 95% CI)
	Poor n (%)	Good n (%)				
Age						
<40	99 (70.2)	42 (29.8)	141	0.358	1.3	
≥ 40	114 (75.0)	38 (25.0)	152			
Sex						
Male	40 (69.0)	18 (31.0)	58	0.476	1.3	
Female	173 (73.6)	62 (60.4)	235			
Highest level of education						
Secondary and lower	5 (50.0)	5 (50.0)	10	0.101	2.8	3 (0.8-11.5)
+Tertiary	208 (73.5)	75 (26.5)	283			
Qualification (grade)						
Medical Officer	21 (55.3)	17 (44.7)	38	0.036	2.6	1.1 (0.6-2.2)
Laboratory officer	5 (55.6)	4 (44.4)	9		2.5	2.8 (1.3-5.9)
Nurse and Midwife	56 (75.7)	18 (24.3)	74		1.0	2.3 (0.6-9.3)
+Community Health Worker	131 (76.2)	41 (23.8)	172			
Years of working experience in medical practice						
<10 years	106 (69.3)	47 (30.7)	153	0.170	1.4	1.5 (0.8-2.6)
+≥10 years	107 (76.4)	33 (23.6)	140			
Have a copy of the SARS-CoV-2 IPC guideline						
Yes	187 (73.3)	68 (26.7)	255	0.526	1.3	
No	26 (68.4)	12 (31.6)	38			
Ever had training on IPC since started working						
Yes	161 (68.8)	73 (31.2)	234	0.003	3.4	3.5 (1.5-8.3)
+No	52 (88.1)	7 (11.9)	59			
Knowledge of IPC						
Good	180 (72.6)	68 (27.4)	248	0.917	1.0	
Fair	33 (73.3)	12 (26.7)	45			
Attitude towards SARS-CoV-2 IPC						
High	138 (70.8)	57 (29.2)	195	0.296	1.3	
Moderate/Low	75 (76.5)	23 (23.5)	98			

+ Reference

these females were more likely to be community health workers, nurses, midwives[20]. The study also found that majority of the respondents were from public health facilities, a finding that is consistent with Fatiregun et al[24] and which is believed to represent the distribution of private-public facilities in the state.

Based on the study, most of the respondents (84.6%) had good knowledge of IPC. This is contrary to previous studies[25-27]. Oboro et al[25] reported 46.0% good knowledge of IPC among the respondents in their study titled "Knowledge, Attitude, and Practice of COVID-19 Infection Prevention and Control among Healthcare workers in Rivers State, Nigeria". However, the high level of knowledge of IPC in this study could be attributed to the high proportion of the respondents who reported to have been trained on IPC and have read either the hard or electronic copy of the national SARS-CoV-2 IPC guidelines. Two-thirds of the respondents in this study reported a high attitude towards SARS-CoV-2 IPC. Oboro et al[25] in a study of knowledge, attitude, and practice of SARS-CoV-2 IPC among healthcare workers in Rivers State, Nigeria reported a slightly lower outcome. The possible explanation is that a high proportion of respondents with good knowledge about IPC in this study could have influenced their high attitude towards SARS-CoV-2 IPC as evident from the findings of the previous studies[28,29]. Furthermore, healthcare workers' concerns and anxiety about the risk of contracting SARS-CoV-2 infection through contact with infected patients within the health care setting during the pandemic could also have influenced the respondents to exercise caution while handling patients hence adapting IPC associated behavioral patterns to protect themselves from being infected with SARS-CoV-2 infection[30-32].

This study also found a low proportion of health care workers with good SARS-CoV-2 IPC practice. Only 21.5% of the respondents reported that they always screen and triage patients for SARS-CoV-2 infection symptoms and isolate them during clinical sessions in the health facility. In this study, 67.6% of the respondents were recruited from primary health care centers purposefully established for providing basic health care service delivery and referral of patients with critical ailments to secondary and tertiary health facilities. These primary health care centers were built without the initial consideration of creating patient holding areas to triage patients within the health facilities[20]. Similarly, previous studies[8,33-36] have reported poor SARS-CoV-2 IPC practices among healthcare workers in low-income settings. Adeoye et al[36] in their study on knowledge, attitude, practice, and predictors of preventive practices toward SARS-CoV-2 infection among healthcare workers in Ogbomosho town in neighboring Oyo state of Nigeria reported a high proportion of healthcare workers (61.1%) with poor SARS-CoV-2 infection, prevention and control practices from a total of 132 respondents interviewed for the study.

This could be attributed to numerous challenges associated with clinical practices, especially during the pandemic in low-income settings[8]. These include a poor working environment vis-à-vis triage and isolation of symptomatic patients[8], PPE shortages such as surgical masks, N95 respirators, gowns, and goggles for frontline healthcare workers with scarcities presently creating a tremendous challenge globally to the health care delivery system because of the pandemic[37]. These challenges are likely to be amplified in Africa, where many healthcare systems are plagued by limited and inequitable funding and the supply of health care commodities[37]. Also, the level of support received from the hospital management team through supportive supervision of health workers on SARS-CoV-2 IPC has been reported by previous authors as key determinants of healthcare workers' IPC practices[26,37]. In this study, it was found that the odds of having good practice of SARS-CoV-2 IPC significantly increased among respondents that have been trained on IPC compared to those that have not been trained. This is consistent with the findings of Ipinnimo et al[38] who reported that IPC training was a significant predictor of the practice of IPC among healthcare workers in a similar study in a neighboring state of Nigeria.

A higher odds of IPC practice among laboratory scientists compared to other professionals was also found in this study. These major findings are consistent with Adeoye et al[36] who reported in their study that laboratory workers have significantly better preventive practices compared to doctors and nurses. The possible explanation might be that laboratory officials are most likely to exercise more cautious and proactive IPC measures in attending to patients as most of their patients are referred to the laboratory for diagnostic investigation by clinical officers after suspecting SARS-CoV-2 infection during clinical examination of these patients thereby giving laboratory officers a guide on the disease they are handling and hence the need to adhere strictly to recommended IPC measures[39].

Furthermore, the research results revealed that knowledge of IPC and attitude towards IPC were not significantly associated with good IPC practice. This is contrary to some previous studies[27,28, 39] as most times, good knowledge from training is a predisposing factor for having better infection prevention practices. However, the findings in this study could be because the study was conducted during the pandemic where there was a global shortage of PPEs due to the high demand in response to the pandemic. Hence, if there is no access to PPE among healthcare workers, they will not be able to practice IPC even if they have adequate knowledge and a high attitude about IPC[39]. How this was not investigated in this study.

The study has the following limitations. Firstly, there may be an information bias given that some aspects of the collected data were self-reported. In addition, social desirability bias might have occurred in some instances because healthcare workers may respond to interview questions in a way that they believe is socially acceptable rather than being completely accurate. However, probing questions were asked to ensure correct responses where possible. Also, the reason for not applying preventive measures was not investigated in our study.

CONCLUSIONS

The study showed good IPC knowledge and a high attitude towards SARS-CoV-2 infection prevention and control among healthcare workers. However, their IPC practice towards SARS-CoV-2 infection prevention and control was suboptimal. Hence, we recommend training and re-training of healthcare workers to address gaps in their compliance with recommended SARS-CoV-2 IPC guidelines during clinical practices. In addition, we recommend an adequate supply of PPEs and other IPC commodities and regular supportive supervision to ensure IPC knowledge is translated into practice among healthcare workers, especially in the fight against the pandemic caused by SARS-CoV-2.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE:
The study was conducted as part of an outbreak investigation and control hence permission to conduct the study was obtained from the State Ministry of Health (SMoH) and the district (LGA) primary Health Care Department. Informed consent was obtained from the respondents. They were made to understand that participation is voluntary and there was no consequence for non-participation. All information obtained was kept confidential.

CONSENT FOR PUBLICATION:
Not applicable.

CONFLICT OF INTERESTS:
The authors declare that they have no conflicts of interest.

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