

Original Article

Knowledge and Practice of Kaduna State Health Care Providers on Infection Prevention and Control during COVID-19 Pandemic

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ABSTRACT

Background: Infection prevention and control (IPC) measures during the novel Coronavirus disease (COVID-19) outbreak is key in minimizing the rate of spread of this infection among health care workers (HCWs) and patients. This study assessed the knowledge and practice of IPC among HCWs in Kaduna State.

Methods: It was a cross-sectional study carried out between April to June 2020. A stratified sampling method was used to select 446 HCWs who were interviewed using a structured interviewer administered questionnaire. Data was collected using Open Data Kit (ODK) Platform on mobile phones. Analyses was done using Statistical Package for Social Sciences (SPSS) version 25.

Results: Three hundred and ten (69.5%) of respondents had good knowledge of COVID-19 with a mean score for knowledge as SD: 12.58. Binary logistic regression showed that factors independently associated with good knowledge were 46-55 years age group (aOR: 0.432; 95% CI 0.027-0.900; and p.0.025). Overall, one hundred and eighty seven (42%) of respondents had good practice scores with a mean score for practice as SD: 9.005. Factors that are significantly associated with IPC practice are ethnicity (Hausa ethnic group) and cadre of personnel (Medical Doctors, Nurses/Midwives, Pharmacist, Community Health officers, Community Health Extension workers, and Environmental Health Officers, Laboratory Scientists/Technicians, and Hospital attendants) which shows decreased odds. Using Pearson's correlation, there is a positive correlation between knowledge of HCWs on COVID-19 infection and infection prevention and control practices ($r = 0.330$, $p = .000$). Conclusion: The study shows appreciably good knowledge of COVID-19 among healthcare workers. Further and continuous training of health workers is needed and adequate personal protective equipment (PPEs) should be



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provided with medical materials needed for good practice.

Keywords: Knowledge, Practice, COVID-19, Health Care, Workers, Infection prevention and control, Kaduna.

INTRODUCTION

The novel coronavirus (COVID-19) pandemic first broke out in Wuhan, China and was first reported in December 31, 2019. It has spread across all regions of the world and was declared a pandemic by World Health Organization (WHO) in March 11, 2020, and therefore, a global emergency.¹⁻³

Corona viruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). Corona virus disease is caused by a novel corona virus named Severe Acute Respiratory Syndrome Corona virus Type 2 (SARS-CoV-2) that affects the respiratory tract and manifests as pneumonia in humans.³ As of September 13, 2020, COVID-19 has been confirmed in over 28,637,952 million individuals worldwide and has resulted in more than 917,417 deaths. More than 211 countries have reported laboratory-confirmed cases of COVID-19. Similarly, the number of confirmed COVID-19 cases in Africa has risen to 1,116,321 and caused 23,916 deaths. While the virus was slow to reach the continent compared to other parts of the world, infection has grown exponentially in recent weeks and continues to spread. As at 12th of September 2020, a total of 56,177 cases have been confirmed in Nigeria and 1,078 deaths were recorded in 36 states and the Federal Capital Territory. Kaduna State has a total of 2,262 confirmed COVID-19 cases with 32 deaths recorded.^{4,5}

There is no specific antiviral treatment recommended for COVID-19, and no vaccine is currently available. At the moment, the therapeutic strategies to deal with the pandemic are only supportive, and thus, preventive strategies aimed at reducing transmission in our health facilities and the community would be our best weapon. The implementation of the preventive and control measures are dependent on the knowledge and practices of healthcare providers.⁶⁻⁸

Infection, prevention and control (IPC) is defined as “a scientific approach and practical solution designed to prevent harm caused by infection to patients and health workers. It is grounded in infectious diseases, epidemiology, social science and health system

strengthening”. The components of IPC are IPC programs; Evidenced-based guidelines; Education and training; Surveillance; Multimodal strategies; Monitoring, audit and feedback; Workload, staffing and bed occupancy; Built environment, material and equipment; based on the WHO guideline.⁹ Infection, prevention and control programs are components of safe, high quality service delivery. Healthcare associated infections (HAIs) are one of the common complications affecting patients and healthcare workers resulting in morbidity, mortality and impacting on health system to function effectively. According to WHO 2011 report, HAIs varies from 5.7% to 19.1% with a pooled prevalence of 10%.^{10,11}

To achieve the highest level of effectiveness in response to the COVID-19 outbreak, IPC programs with dedicated teams or focal points should be in place. Where this is limited or inexistent, WHO recommends implementation of minimum requirements at national and facility level. Minimum requirements are defined as IPC standards that should be in place to provide minimum protection and safety to patients, Healthcare workers (HCWs) and visitors based on the WHO components for IPC programmes.¹⁰

Infection prevention and control strategies to prevent or limit transmission in health care settings as defined by WHO involves ensuring triage, applying standard precautions for all patients, implementing empiric additional precautions (droplet, contact and airborne precautions) for suspected cases of COVID-19, implementing administrative controls and using environmental and engineering controls.^{9,12} These measures are aimed at limiting human-to-human transmission and reduction of secondary infections.

The need to assess the knowledge and practice of healthcare providers on infection control is born out of the need to prevent the ravaging effect of COVID-19¹³ by appropriate use of contact and droplet precautions among HCWs during the management of suspected cases and prioritization of care of symptomatic patients.⁹

In China over 2000 healthcare workers were reported to be infected with COVID-19 due to inadequate personal protection and knowledge of the pathogens as well as awareness on the use of PPEs.¹⁴ According to analysis by CDC, 780 out of 1,423 HCW patients reported having had contact with laboratory confirmed COVID-19 case in health care setting within 14 days before onset of symptoms between February 12th to April 9th 2020 in USA.¹⁵ while in Nigeria, 113 HCWs were infected with COVID-19 from February 27th to May 2, 2020.¹⁶ As of 8 April 2020, 22,073 cases of COVID-19 among HCWs from 52 countries had been reported to WHO.¹²

Study conducted by Olorunfemi among HCWs in Nasarawa state Northern Nigeria implied that inadequate workers' knowledge and environment related problems, including the lack of protective materials and other equipment and utilities required to ensure safety of HCWs are critical issues that need urgent attention. Institution of a surveillance system for HAIs to improve consistent use of standard precautions among HCWs is recommended in Nigeria and other low-income countries in Africa.¹⁷

Evidence in developing countries showed that inadequate infection prevention knowledge, unsafe practices and insufficient compliance with preventive measures were common among healthcare workers.¹⁸⁻²² While studies in Nigeria and other countries showed mixed results in the knowledge and practice of IPC among HCWs, there is good knowledge about control measures for infective diseases such as tuberculosis, HIV/AIDS and Hepatitis but little is known about COVID-19 because the novel infection is evolving.^{3,18,22-24} Ireye *et al* showed that IPC practices across all cadres of HCWs from both government-owned and privately-owned health facilities in Edo state Nigeria were found to be poor in over 50% of HCWs that participated in the study. Poor IPC practices generally place HCWs at risk of HAIs¹⁹.

Therefore, this study is targeted at HCWs knowledge and practices on COVID-19 IPC in Kaduna State with the aim to guide policy makers on developing policy on IPC. Kaduna state is a potential high-risk state for infectious disease transmission as it serves as transit area for many passengers coming from different parts of Nigeria. The state is among the 36 states plus Federal Capital Territory that have reported COVID-19 in Nigeria, the first case was reported on 28th March 2020 (total confirmed cases are 2,262), accounting for 4.07% of total Corona virus burden in Nigeria as at

12th September, 2020.⁵ Thus, assessment of level of knowledge of COVID-19 and practices of IPC as well as the factors that influence implementation of IPC among HCWs in the different tiers of health care setting in Kaduna State is paramount.

METHODS

Kaduna state has a total of 1,284 public hospitals spread across its three senatorial zones and 255 political wards. The state has 6 tertiary, 28 secondary and 1,250 primary health care facilities. The National Primary Healthcare Development Agency (NPHCDA) on 11th March, 2020 supported the training of 10, 531 healthcare workers on IPC.

A cross sectional study design was carried out. The study was done among permanently employed healthcare workers in the public health care service. They were doctors, nurses, pharmacists, laboratory scientists/technician, medical health record officers, community health extension workers, community health officers, environmental health workers and hospital/ward attendants who are currently working at facilities in the state. Healthcare workers not on permanent employment were excluded. The sample size was calculated using the Cochran's formula.³⁴ A 10% non-response assumption was assumed giving a total of 422. A two-stage sampling method was applied to select healthcare facilities and Healthcare workers from primary, secondary and tertiary health facilities.

Stage 1: Selection of health facilities: A total of eighty-seven healthcare facilities were selected from each level of health care facilities using stratified sampling. One tertiary and one specialist hospital were selected using simple random sampling by balloting out of the six in the state. Eight secondary healthcare facilities were selected by balloting out of the twenty-eight and 77 PHCs were also selected by simple random sampling from the 255 PHCs in the state.

Stage 2: Selection of health workers: A sampling frame of all categories of health workers from the different level of care was obtained and categorized in strata. Total HCWs from the selected 87 Healthcare Facilities (HFs) = 2,393

Sample size from each category at different levels to get the proportion required was gotten using the following formula: Number of HCWs by category, by level / Total number of HCWs

in the selected 87 HF's (=2,393) * Sample size (422). A simple random sampling (balloting) method was applied to select each category of health worker from the different levels of care.

Data Collection

Data was collected using Open Data Kit (ODK) Platform on mobile phones. A structured interviewer administered questionnaire adapted from WHO risk assessment tool.²⁵ The questionnaire comprised four sections bio- demographic data, knowledge on COVID-19 IPC, practice related to COVID-19 prevention and factors influencing knowledge and practice. The questionnaire was pretested among healthcare workers in a tertiary hospital within Kaduna metropolis. The questions were found to be acceptable by all cadres and the response rate on all questions was 100% with a response time of 15-18 minutes per participant. Data was collected by trained research assistants and were supervised.

Knowledge of COVID-19 IPC was measured using 10 questions. For every correct response, 1 point was awarded and 0 for an incorrect response giving a score range of 0 to 28. This variable was grouped based on the grouping in USAID Infection Prevention and Control assessment tool²⁶ - as assessment score, possible score, percent score and rating (good knowledge was a score of > 75%, fair knowledge was a score of 50% -74% and poor knowledge was a score of < 50%.

Practice of Covid-19 IPC was assessed using 14 structured questions using four-point Likert's scale rating. That is always, most of the time, occasionally, and never. In the 14 practice questions, scores of 4, 3, 2 and 1 was given for, always as recommended, most of the time, occasionally and never respectively. Therefore, practice score ranges from 14–56. Scores were presented in percentages grouped as recommended in the USAID Infection Prevention and Control assessment tool as:²⁶ good practice was a score of >75%, fair practice was a score of 50% to 74% and poor practice was a score of <50%.

Data Analysis

Data was analyzed and SPSS software version 25 (IBM). Result was presented as percentages, standard deviation and adjusted odds ratio (aOR). Analysis of variance and independents T-test was used to compare differences in mean scores of knowledge and practice

among variables. Possible associations between the independent variables and knowledge and practice were assessed using binary logistic regressions.

Ethical Considerations

Ethical approval to carry out the study was obtained from the Kaduna State Ministry of Health, Health ethical review committee with approval number (NHREC/03/17/2018). A written informed consent was obtained from each participant using hard copies of the informed consent forms before the administration of research questionnaire using ODK. All copies of signed consent forms are in a secured location with restricted access.

RESULTS

Table 1 and 2 shows all 446 healthcare workers selected were interviewed with a response rate of 100%. Three hundred and thirteen (70.2%) respondents were female while one hundred and thirty three (29.8%) were male. Mean age of respondents was 38.92 years (SD: 9.12) while the mean years of experience as a healthcare worker was 12.84 years (SD: 8.019, SEM 0.3797). Nurses/midwives constitutes the highest percentage among cadre of healthcare workers 29% (n=131) with the least being the community health officers 2.9% (n=13). One hundred and ninety eight (44.4%) respondents had a diploma as their highest qualifications followed by those with certificates 30.3% (n=135), degree 18.8% (n=84), masters 4.0% (n=18) and those with non-formal education 2.5% (n=11). The Hausa's constituted the largest ethnic groups 46.2% (n=206) while the Igbos made up the least number interviewed 1.8% (n=8).

Table 3 shows that 310 (69.5%) of respondents had good knowledge of COVID-19, with a mean score SD: 12.58.

Table 4 shows comparison of mean scores (ANOVA & Independent student's T test) for knowledge by marital status had shown that there are no significant differences between the married, singles, divorced and widows (p=0.7817). Similarly, differences in knowledge of COVID-19 by ethnic groups (p=0.1541), aged group (p=0.2828), gender (p=0.5631), years of experience (p=0.3132) were not statistically significant. This corroborates a recent study conducted in Uganda³¹. However,

Significant differences in knowledge were observed by facility type (p=0.0106). Tukey's Post-hoc test has shown that Primary health care facilities were found to be significantly different from both secondary (adjusted p value=0.0205) and tertiary facilities. (adjusted p value of 0.0341) were as differences between secondary and tertiary facilities were not statistically significant (adjusted p=0.8273). Other variables with significant differences in knowledge of COVID-19 by highest level of qualification (p<0.0001) and knowledge of COVID-19 by cadre (p<0.0001) with differences observed between medical doctors and hospital attendants (p=0.0185), Nurses/midwives and CHEWs (p=0.0140), nurses and Hospital attendants (P=0.0007).

Overall, respondents with good practice scores are 187 (42%) while those with fair practice scores are 49% (n=217) and those with poor practice are 9% (n=42%). Mean score for practice is 40.45 (SD; 9.005, SEM 0.4264). Variables with the highest percentage of good practice scores were medical Doctors (75%) by cadre; Tertiary hospital (56%) by facility type; those with masters and above (61%) by educational level, the Singles (56%) by marital level; 11-20 years and 31years and above (56% each) by years of experience; Igbos (100%) by ethnicity; 25 years and below and 46-55 year (45%each) by age distribution and females (42%) by gender.

Differences in IPC practices were seen not to be significantly for three variables and these are by age group (p=0.7233), Gender (p=0.5434), years of experience (p=0.1418). However, significant differences were observed in IPC practice by marital status (p=0.0080), facility type (p=0.0148), ethnic group (p<0.0001), qualification (p<0.0001) by cadre (p<0.0001). Tukey's Post-Hoc test has shown that there is significant difference between the widows and the married (adjusted p values 0.0081) only while other marital status were not significantly different from each other. Also, and by cadre only the differences between secondary and tertiary facilities were significantly different (adjusted p value 0.0496).

Factors associated with good practice (Table 5) are Hausa (aOR: 0.569; 95%CI 0.351-0.923; and P-Value: p=0.022) Medical Doctors (aOR: 0.049; 95%CI 0.010-0.240; and P-Value: p=0.000) Nurses/Midwives (aOR: 0.092; 95%CI 0.032-0.268; and P-Value: p=0.000) Pharmacist (aOR: 0.211; 95%CI 0.061-0.731; and P-Value: p=0.014) Community Health officers (aOR: 0.195; 95%CI 0.039-0.971; and p=0.046) Community Health Extension workers (aOR: 0.255; 95%CI 0.075-0.861; and p=0.028) Environmental

Table 1. Socio-demographic characteristics (N=446)

Variable	Frequency (%)
Marital Status	
Married	369 (82.7)
Single	55 (12.3)
Divorce	5 (1.1)
Widows	17 (3.8)
Category of Health facilities.	
Primary Health care	135 (30.3)
Secondary Health care	241 (54.0)
Tertiary Health care	70 (15.7)
Ethnic group	
Yoruba	36 (8.1)
Igbo	8 (1.8)
Hausa	206 (46.2)
Others	196 (43.9)
Age of respondents	
25 years and below	29 (6.5)
26-35 years	145 (32.5)
36-45 years	146 (32.7)
46-55 years	110 (24.7)
56 years and above	16 (3.6)
Sex	
Male	133 (29.8)
Female	313 (70.2)
Years of experience	
1-10 years	202 (45.3)
11-20 years	183 (41.0)
21-30 years	45 (10.1)
31- years and above	16 (3.6)
Highest Educational level of respondents	
Informal*	11 (2.5)
Certificate	135 (30.3)
Diploma	198 (44.4)
Bachelor	84 (18.8)
Masters and above	18 (4.0)
Cadre of health worker	
Medical Doctors	24 (5.4)
Nurses/Midwives	131 (29.4)
Pharmacist	35 (7.8)
Community Health officers	13 (2.9)
Community Health Extension workers	56 (12.6)
Environmental Health Officers	28 (6.3)
Laboratory Scientists/Technicians	50 (11.2)
Hospital Attendants	65 (14.6)
Health Record Officers	44 (9.9)

*Informal refers to educational level at secondary school and below

Table 2. Questions knowledge and practice of Kaduna State Health Care Providers on IPC during COVID-19 pandemic

Questions	Total response	Frequency (%)
Knowledge		
Which of the following are effective methods for prevention of COVID-19 infection in the health care setting?	446	426 (96)
What personnel protection equipment (PPE) should be worn by individuals transporting patient who are confirmed with COVID-19 within a healthcare facility?	1784	1630 (91)
What personnel protection equipment (PPE) should be worn by individuals transporting patient who are under investigation for COVID-19 within a healthcare facility?	1784	1627 (91)
Which of the following is recommended for isolation of a patient with confirmed case of COVID-19?	446	437 (98)
Which of the following is recommended for isolation of a patient under investigation for COVID-19?	446	425 (95)
Preferred method of hand hygiene includes the following	892	676 (76)
Which of the following are true regarding respiratory hygiene/etiquette	1338	1081 (81)
Triage in health facility during COVID19 pandemic is done in the following location(s)	1784	688 (39)
It is very important to conduct triage in all health care facilities providing services during COVID 19 pandemic for the following reason(s):	1784	1105 (62)
The following items are necessary for triage except:	2676	801 (30)
Practice		
During your health care interaction with patients, do you perform hand hygiene before and after any clean or aseptic procedure?	1784	1575 (88)
During your health care interaction with patients, do you perform hand hygiene after exposure to body fluids?	1784	1655 (93)
During your health care interaction with patients, do you perform hand hygiene after touching patients' surroundings (bed, door handle)?	1784	1531 (86)
During your health care interaction, were high-touched surfaces decontaminated frequently (at least three times daily)?	1784	1250 (70)
Is distance of at least meters (arm's length) maintained between health worker and patients and in between patients?	1784	1449 (81)
Do you wear hand gloves when performing any aseptic procedures?	1784	1574 (88)
Do you screen patients to identify patients with respiratory illness?	1784	1300 (73)
Do you separate patients with respiratory illness from others?	1784	1320 (74)

Table 2 Continued.
Questions knowledge and practice of Kaduna State Health Care Providers on IPC during COVID -19 pandemic

Questions	Total response	Frequency (%)
Do you educate patients with respiratory illness on respiratory hygiene?	1784	1424 (80)
During aerosol generating procedures on patients, do you wear single-use gloves?	1784	1441 (81)
During aerosol generating procedures on patients, do you wear Face shield or goggles/protective glasses?	1784	840 (47)
During aerosol generating procedures on patients, do you wear Disposable gown?	1784	772 (43)
During aerosol generating procedures on patients, do you wear Water proof apron?	1784	844 (47)
During aerosol generating procedures on patients, do you wear N Mask (or equivalent respirator)?	1784	1066 (60)
Other factors influencing practice		
Have you had any form of training on infection prevention and control?	446	306 (69)
Have you had any training on COVID-9 IPC?	446	362 (81)
Have you had any form of training on hospital waste management?	446	361 (81)
Does your health facility have Guidelines on COVID-9 IPC?	446	313 (70)
Are triaging points established in your facility?	446	316 (71)
Are hand hygiene points established in your facility at strategic locations?	446	436 (98)
Does your facility have holding/isolation centre for keeping suspected cases of COVID-9?	446	106 (24)
Has your facility cascaded the training on IPC to all staff?	446	285 (64)

Table 3. Frequency of Scores by variables on knowledge and practice of Kaduna state Health Care Providers on IPC during COVID-19 pandemic

	Total response	Knowledge			Practice		
		Good Frequency (%)	Fair Frequency (%)	Poor Frequency (%)	Good Frequency (%)	Fair Frequency (%)	Poor Frequency (%)
State summary	466	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Marital Status							
Married	369	252 (68)	114 (31)	3 (1)	159 (43)	179 (49)	31 (8)
Single	55	43 (78)	12 (22)	0 (0)	18 (33)	31 (56)	6 (11)
Divorce	5	3 (60)	2 (40)	0 (0)	4 (80)	1 (20)	0 (0)
Widows	17	12 (71)	5 (29)	0 (0)	6 (35)	6 (35)	5 (30)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Category of Health facilities							
Primary Health care	135	84 (62)	48 (36)	3 (2)	59 (44)	68 (50)	8 (6)
Secondary Health care	243	175 (72)	68 (28)	0 (0)	89 (37)	126 (52)	26 (11)
Tertiary Health care	68	51 (75)	17 (25)	0 (0)	39 (56)	23 (33)	8 (11)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Ethnic group							
Yoruba	36	28 (78)	8 (22)	0 (0)	23 (64)	12 (33)	1 (3)
Igbo	8	7 (88)	1 (12)	0 (0)	8 (100)	0 (0)	0 (0)
Hausa	206	142 (69)	63 (30.5)	1 (0.5)	93 (45)	96 (47)	17 (8)
Others	196	133 (68)	61 (31)	2 (1)	63 (32)	109 (56)	24 (12)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Age of respondents							
25 years and below	29	25 (86)	4 (14)	0 (0)	13 (45)	14 (48)	2 (7)
22_35 years	146	91 (62)	54 (37)	1 (1)	59 (40)	72 (49)	15 (10)
36_45	145	98 (68)	47 (32)	0 (0)	58 (40)	75 (52)	12 (8)
46_55	110	84 (76)	24 (22)	2 (2)	50 (45)	49 (45)	11 (10)
55 years and above	16	12 (75)	4 (25)	0 (0)	7 (44)	7 (44)	2 (12)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Sex							
Male	133	89 (67)	42 (32)	2 (2)	54 (41)	62 (47)	17 (13)
Female	313	221 (70)	91 (29.7)	1 (0.3)	133 (42)	155 (50)	25 (8)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Years of experience							
1_10 years	202	141 (70)	61 (30)	0 (0)	84 (42)	91 (45)	27 (13)

Table 3 Continued .

Frequency of Scores by variables on knowledge and practice of Kaduna state Health Care Providers on IPC during COVID-19 pandemic

	Total response	Knowledge			Practice		
		Good Frequency (%)	Fair Frequency (%)	Poor Frequency (%)	Good Frequency (%)	Fair Frequency (%)	Poor Frequency (%)
11_20 years	183	120 (66)	61 (33)	2 (1)	103 (56)	73 (40)	7 (4)
21_30 years	45	36 (80)	8 (18)	1 (2)	20 (44)	18 (40)	7 (16)
31_ years and above	16	13 (81)	3 (19)	0 (0)	9 (56)	6 (38)	1 (6)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Highest Educational level of respondents							
Non-Formal	11	8 (73)	3 (27)	0 (0)	3 (27)	2 (18)	6 (55)
Certificate	135	76 (56)	57 (42)	2 (1)	36 (27)	87 (64)	12 (9)
Diploma	198	146 (74)	51 (26)	1 (1)	92 (46)	87 (44)	19 (10)
Degree	84	66 (79)	18 (21)	0 (0)	45 (54)	34 (40)	5 (6)
Masters and above	18	14 (78)	4 (22)	0 (0)	11 (61)	7 (39)	0 (0)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)
Cadre of health worker							
Medical Doctors	24	19 (79)	5 (21)	0 (0)	18 (75)	6 (25)	0 (0)
Nurses/Midwives	131	107 (82)	24 (18)	0 (0)	68 (52)	63 (48)	0 (0)
Pharmacist	35	20 (57)	15 (43)	0 (0)	15 (43)	17 (49)	3 (9)
Community Health officers	13	7 (54)	6 (46)	0 (0)	7 (54)	6 (46)	0 (0)
Community Health Extension workers	56	31 (55)	25 (45)	0 (0)	24 (43)	31 (55)	1 (2)
Environmental Health Officers	28	19 (68)	8 (29)	1 (4)	12 (43)	12 (43)	4 (14)
Laboratory Scientists/Technicians	50	39 (78)	11 (22)	0 (0)	20 (40)	27 (54)	3 (6)
Hospital Attendants	65	38 (58)	25 (38)	2 (3)	18 (28)	30 (46)	17 (26)
Health Record Officers	44	30 (68)	14 (32)	0 (0)	5 (11)	25 (57)	14 (32)
Total	446	310 (69.5)	133 (29.8)	3 (0.7)	187 (42)	217 (49)	42 (9)

Health Officers (aOR: 0.231; 95%CI 0.062-0.866; and p=0.030) Laboratory Scientists/Technicians (aOR: 0.208; 95%CI 0.065-0.665; and p=0.008) Hospital Attendants (aOR: 0.158; 95%CI 0.045-0.555; and p=0.004).

Table 5 shows that knowledge is significantly associated with practice (aOR: 0.399; 95%CI 0.257-0.618; and p=0.000) but with lower odds.

Table 4. Mean percentage scores for IPC knowledge and practice

	Knowledge			Practice		
	Mean score	±SEM	Anova/Independent T-test P-Value	Mean score	±SEM	Anova/Independent T-test P-Value
Marital Status						
Married	70.98	±0.676	<i>p</i> =0.782	40.8	±0.463	<i>p</i> =0.008
Single	72.73	±1.254		39.9	±1.170	
Divorce	70	±6.248		45.4	±1.750	
Widows	72.26	±3.101		33.7	±2.690	
Category of Health facilities.						
Primary Health care	68.57	±1.289	<i>p</i> =0.011	41.6	±0.780	
Secondary Health care	72.17	±0.718		39.3	±0.527	
Tertiary Health care	73.16	±1.367		42.2	±1.310	
Ethnic group						
Yoruba	75.69	±1.991	<i>p</i> =0.154	45.3	±1.220	<i>p</i> =0.000
Igbo	73.23	±3.013		47	±1.410	
Hausa	70.67	±0.9531		41.4	±0.659	
Others	70.94	±0.8191		38.3	±0.594	
Age of respondents						
25 years and below	72.29	±1.721	<i>p</i> =0.282	37.7	±1.970	<i>p</i> =0.723
26-35 years	70.38	±1.298		39.5	±0.889	
36-45 years	71.89	±1.291		39.9	±0.932	
46-55 years	73.17	±1.335		40.3	±0.963	
55 years and above	78.56	±4.730		41.9	±3.890	
Sex						
Male	70.71	±1.169	<i>p</i> =0.157	40.1	±0.859	<i>p</i> =0.287
Female	71.46	±0.688		40.6	±0.486	
Years of experience						
1-10 years	71.38	±0.8155	<i>p</i> =0.313	39.7	±0.655	<i>p</i> =0.142
11-20 years	70.26	±0.999		41	±0.642	
21-30 years	73.96	±1.983		39.8	±1.300	
31- years and above	72.99	±2.664		44.4	±2.160	
Highest Educational level of respondents						
Informal	68.19	±4.204	<i>p</i> =0.000	28.7	±4.380	<i>p</i> =0.000
Certificate	65.85	±1.159		37.7	±0.682	
Diploma	72.85	±0.8356		41.6	±0.633	
Degree	75.09	±1.073		42.3	±0.829	
Masters and above	77.77	±2.719		47.1	±2.010	
Cadre of health worker						
Medical Doctors	76.79	±2.06	<i>p</i> =0.000	47.2	±1.56	<i>p</i> =0.000
Nurses/Midwives	74.72	±0.877		43.1	±0.559	
Pharmacist	69.19	±2.188		39.6	±1.34	
Community Health officers	67.58	±2.507		42.8	±2.56	
Community Health Extension workers	67.86	±1.920		42.8	±1.03	
Environmental Health Officers	70.03	±3.133		39.5	±1.84	
Laboratory Scientists/Technicians	73.64	±1.495		41.7	±1.01	
Hospital Attendants	66.76	±1.860		34.8	±1.35	
Health Record Officers	69.48	±1.542		33.4	±1.36	

Pearson correlation model summary

R R-Squared Adjusted R-squared standard Error of the estimate
 0.33 0.109 0.107 8.51108

Predictors: Knowledge of health care workers; Dependent variable: infection prevention and control practices

Table 5. Predictors of good knowledge and good practice among Kaduna state Health Care Providers on IPC during COVID-19 pandemic

Variables	Good Knowledge aOR(95%CI); P-value	Good Practice aOR(95%CI); P-value
Marital Status		
Married	0.961(0.288-3.214); <i>p</i> =0.949	1.022(0.308-3.393); <i>p</i> =0.971
Single	0.785(0.187-3.296); <i>p</i> =0.741	2.130(0.503-9.021); <i>p</i> =0.305
Divorce	0.857(0.055-13.298); <i>p</i> =0.912	0.352(0.020-6.269); <i>p</i> =0.477
Widows	Ref	Ref
Category of Health facilities.		
Primary Health care	0.663(0.254-1.729); <i>p</i> =0.400	0.803(0.322-2.001); <i>p</i> =0.638
Secondary Health care	0.730(0.334-1.595); <i>p</i> =0.430	1.622(0.778-3.385); <i>p</i> =0.197
Tertiary Health care	Ref	Ref
Ethnic group		
Yoruba	0.701(0.260-1.889); <i>p</i> =0.483	0.442(0.187-1.046); <i>p</i> =0.063
Igbo	0.389(0.042-3.571); <i>p</i> =0.404	0.000(0.000-0.000); <i>p</i> =0.999
Hausa	0.691(0.421-1.135); <i>p</i> =0.145	0.569(0.351-0.923); <i>p</i> =0.022
Others	Ref	Ref
Age of respondents		
25 years and below	2.083(0.443-9.790); <i>p</i> =0.353	1.045(0.306-3.571); <i>p</i> =0.944
26-35 years	0.545(0.168-1.776); <i>p</i> =0.314	0.857(0.302-2.430); <i>p</i> =0.772
36-45 years	0.702(0.215-2.293); <i>p</i> =0.558	0.872(0.308-2.471); <i>p</i> =0.796
46-55 years	1.077(0.320-3.626); <i>p</i> =0.905	1.071(0.372-3.082); <i>p</i> =0.898
55 years and above	Ref	Ref
Sex		
Male	1.375(0.742-2.550); <i>p</i> =0.312	1.118(0.598-2.090); <i>p</i> =0.726
Female	Ref	Ref
Years of experience		
1-10 years	1.401(0.295-6.643); <i>p</i> =0.671	2.789(0.614-12.658); <i>p</i> =0.184
11-20 years	1.758(0.395-7.824); <i>p</i> =0.459	3.969(0.932-16.905); <i>p</i> =0.620
21-30 years	0.969(0.188-4.984); <i>p</i> =0.970	3.397(0.733-15.744); <i>p</i> =0.118
31- years and above	Ref	Ref
Highest Educational level of respondents		
Non-Formal	1.831(0.210-15.968); <i>p</i> =0.584	1.692(0.212-13.496); <i>p</i> =0.619
Certificate	3.880(0.768-19.587); <i>p</i> =0.101	1.563(0.362-6.747); <i>p</i> =0.550
Diploma	1.666(0.351-7.894); <i>p</i> =0.520	0.565(0.142-2.253); <i>p</i> =0.419
Degree	1.086(0.262-4.500); <i>p</i> =0.910	0.427(0.117-1.558); <i>p</i> =0.198
Masters and above	Ref	Ref
Cadre Health Facility staff interviewed		
Medical Doctors	0.894(0.198-4.029); <i>p</i> =0.884	0.049(0.010-0.240); <i>p</i> =0.000
Nurses/Midwives	0.465(0.198-1.095); <i>p</i> =0.080	0.092(0.032-0.268); <i>p</i> =0.000
Pharmacist	2.305(0.793-6.695); <i>p</i> =0.125	0.211(0.061-0.731); <i>p</i> =0.014
Community Health officers	2.317(0.520-10.327); <i>p</i> =0.270	0.195(0.039-0.971); <i>p</i> =0.046
Community Health Extension workers	1.902(0.678-5.332); <i>p</i> =0.222	0.255(0.075-0.861); <i>p</i> =0.028
Environmental Health Officers	1.163(0.358-3.781); <i>p</i> =0.802	0.231(0.062-0.866); <i>p</i> =0.030
Laboratory Scientists/Technicians	0.656(0.241-1.784); <i>p</i> =0.409	0.208(0.065-0.665); <i>p</i> =0.008
Hospital Attendants	0.926(0.343-2.499); <i>p</i> =0.880	0.158(0.045-0.555); <i>p</i> =0.004
Health Record Officers	Ref	Ref
Good knowledge		0.399(0.257-0.618); <i>p</i> =0.000

aOR: adjusted odds ratio

DISCUSSION

The study showed that there is good knowledge of IPC among HCWs in the state with a mean score of SD:12.58. Some studies reported higher values of good knowledge of IPC among HCWs; these includes Vietnam (88.4%), Afghanistan (85%), Pakistan (93.2%), China (89%) and Ethiopia (88.2%) respectively.^{26,27,28,29,30} In contrast to our study, lower values for knowledge on IPC among HCWs have been reported by other researchers within Nigeria and in other climes like South-South Nigeria (56%)³², Uganda (69%)³¹ and Ghana (65.1%).³³

The study revealed that up to 30% of Healthcare workers in the state were not trained on COVID-19 Infection prevention and control. This attributed to the lower value for good knowledge of HCWs, which should be looked into by the state to retrain HCWs on IPCs across all the 3 tiers of healthcare settings especially with the continuous rising number of cases in the country. Differences in knowledge within variables were observed however, some were not significant. The negative prediction of knowledge on some variables is because of lack of adequate training and availability of guidelines on IPC at Healthcare facilities. Practically, it is expected that the more an individual acquires training the more he/she knows and practices what he/she has learnt in reality.

It is observed that in majority of cases the higher the cadre, qualification and years of experience of HCWs the more knowledgeable on IPC. Thus, non-formal education, respondents with Certificates, Diploma, Degree, Pharmacist, Community Health officers and Environmental Health Officers are all associated with increase odds of good knowledge for COVID-19 but the values are not statistically significant ($p > 0.05$). This might be because probably the duration of contact with clients is not as long as that observed as the case with the medical Doctors, nurses/midwives and lab scientists in healthcare settings and though mindful of HAIs. Knowledge by facility type shows that HCWs in the tertiary and secondary health care setting have better knowledge on COVID-19 IPC than HCWs in the primary health facility. Overall, questions on triage had the lowest score. Healthcare workers poor knowledge on triaging is a major concern it is an area which needs to be strengthened during refresher training in the state. Infection, prevention and control (IPC) practices in the state is sub-optimal with only 42% demonstrating good practice and observed

that majority were from tertiary Healthcare facilities a possible reason might be due to constant availability and utilization of PPEs and adherence to IPC precautionary measures at time of surgical procedures that occur more often at higher level than lower of healthcare setting in the state. Also, the lack of positioning of adequate materials for good practice at the time of survey and isolation rooms at primary health care setting must have contributed to the sub-optimal practice noted at that level.

Mean score for practice by other ethnic groups were significantly different from the Hausas, Igbos and Yoruba's. Such significant differences might not be clearly understood now but we might suggest individual differences since across variables, there are health workers with good IPC practices scores though to varying degrees.

It is observed that none of the variables were associated with higher odds of good practices. However, the following variables are associated with lower odds of good practice though they are statistically significant ($P < 0.05$) and they include Hausa, medical Doctors Nurses/Midwives, Pharmacists, Community Health officers, Community Health Extension Workers Environmental Health Officers, Laboratory Scientists/Technicians, and Hospital Attendants. Generally, the poor performance in IPC practice might be attributable to inadequate knowledge on triage, a fairly large proportion of the healthcare workers have not been trained (30%), inadequate PPEs (47% without PPEs), non-availability of COVID-19 guidelines (30% of health facilities) as shown by our study.

Pearson correlation showed a positive correlation between knowledge of health care workers on COVID-19 infection and infection prevention and control practices ($r = 0.330, p = .000$), Binary Logistic regression indicates Good knowledge is also seen to be significantly ($P < 0.05$) associated with good practice but with decreased odds. This might be expected as the score for IPC practice is very low in the state. Attitude of health workers might explain this as with some studies³¹ but unfortunately, our study did not consider association with the attitude of healthcare workers with practice.

Some of the limitations of the studies are questions on IPC practice is focused towards Healthcare workers involved in case management of patients and may not apply to certain category of health workers who have different roles & responsibilities in the

COVID-19 response. This study examines the relationship between knowledge and practice without putting attitude and other factors of Healthcare workers into consideration. Lack of similar studies in the state also limits adequate comparison of data obtained.

CONCLUSION

Our study therefore shows that there is generally good knowledge of COVID-19 among healthcare workers but gaps exist in IPC practices. We therefore recommend training and retraining of healthcare workers on IPC with a target of greater than 90% of HCWs trained. All private practitioners/ all the different professional groups in the state should be included in continuous and regular training. Sharing of COVID-19 response and treatment protocol, guidelines to all categories of HCWs including both public and private healthcare workers should be a priority in the state. Facilities without adequate PPEs should be identified and listed to ensure that PPEs and other materials needed for good practices are provided. Government should continue good stimulus packages, ensure workplace safety and frontline staffers are engaged on adequate hospital infection, prevention and control policy. Future studies should include attitude as a study variable and also focusing on the different roles and responsibilities of each cadre of healthcare worker during the COVID-19 response

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SGI, HAI, JS, AZ, SI, TO, MS, HBM LS, EM analyzed and interpreted the data. HAI, SGI, LS, EM, GCU and DM managed literature search. SGI, HAI, II, SCB, HBM, critically reviewed the document for intellectual content. All authors made review of the document, made input and approved the final paper.

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