



Research article

Self-reported use of and access to personal protective equipment among healthcare workers during the COVID-19 outbreak in Nigeria



David Ayoola Oladele^{a,*}, Ifeoma Eugenia Idigbe^a, Adesola Zaidat Musa^b,
Titilola Gbaja-Biamila^a, Tajudeen Bamidele^c, Aigbe Gregory Ohihoin^a, Abideen Salako^a,
Tosin Odubela^a, Oluwagbemiga Aina^d, Esther Ohihoin^a, Agatha David^a, Oliver Ezechi^a,
Nkiruka Odunukwe^a, Babatunde Lawal Salako^a

^a Clinical Sciences Department, Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria

^b Monitoring and Evaluation Unit, Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria

^c Department of Molecular Biology, Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria

^d Department of Biochemistry and Nutrition, Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria

ARTICLE INFO

Keywords:

COVID-19
Personal protective equipment
Healthcare workers
Nigeria
Self-reported use
Access

ABSTRACT

The SARS-CoV-2 virus is highly infectious resulting in increased infection and death among the front-line Healthcare Workers (HCW) because of limited access to personal protective equipment (PPE). This study assesses the availability and self-reported use of PPE amongst HCW during the COVID-19 pandemic in Nigeria. A mixed-method study was conducted through a cross-sectional survey and in-depth interviews amongst HCW. Quantitative data analysis was done using SPSS version 26 and thematic analysis was done for the in-depth interview. A total of 258 HCW completed the survey while 15 HCW took part in the in-depth interview. The mean age was 40 (± 8.6) years, 67.4% were female and 83.3% were married. 49% were Doctors, 21.1% were Nurses, 28.7% were other allied HCW and 62.2% had at least 10 years of practice experience. Only 22.1% of HCWs had regular access to PPE and only 20.6% had access to N-95 facemask compare to other PPEs. Male HCWs and those working at secondary or tertiary facilities had access to N-95 facemask (p-value 0.025 and 0.010 respectively). The facilitator of PPE use is leadership quality of hospital head and donation of PPE to the facilities while the barriers to PPE use include a limited supply of PPE, as well as facility's infrastructural and operational challenges. The study reported limited access to essential PPE with varying perspectives on its use. Therefore, access, knowledge, and appropriate use of PPE need urgent attention with improved implementation of infection control policy at the facility level.

1. Introduction

The novel coronavirus thought to be primarily a zoonotic infection has emerged as a very important global public health challenge. The World Health Organization (WHO) on February 11, 2020, named the 2019 SARS-CoV-2 infection 'COVID-19' [1, 2] and the disease was declared a public health emergency of international concern on the 30th January 2020, with total global total infection at 50,676,072 and mortality of 1,261,075 [3] as of November 10, 2020.

The first reported case in the African continent was on February 14, 2020 and as of November 10, 2020, according to the Africa Centre for Disease Control (Africa CDC), there have been 1,894,367 confirmed cases and 45,647 deaths on the continent [4]. Nigeria reported the first case of COVID-19 on February 27, 2020 and the country had a total of 64,336 confirmed cases with 1,160 deaths as of November 11, 2020 [5].

The virulence of the SARS-CoV-2 virus is of international concern because of the ease of its person-to-person spread and the fact that asymptomatic individuals can transmit the virus. This ease of infectivity

* Corresponding author.

E-mail address: daveohlay@yahoo.com (D.A. Oladele).

<https://doi.org/10.1016/j.heliyon.2021.e07100>

Received 8 January 2021; Received in revised form 2 April 2021; Accepted 14 May 2021

2405-8440/© 2021 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

predisposes the front-line responders to an increased risk of contracting the infection while providing care for patients in healthcare settings.

Globally, the rate of infection among health workers (HCW) is about 10%, with 35,000 health care worker infections reported by the WHO as of April 21, 2020 [6]. Amnesty International reported over 7000 global death among health workers to COVID-19 as of 3rd September 2020 [7] and in Nigeria, as of 3rd June 2020, 812 HCW had confirmed diagnosis of COVID-19 [8]. It, therefore, follows from the above that to protect the HCW, there must be appropriate training on IPC and access to the requisite PPE in healthcare settings.

With the increasing spread of the COVID-19 pandemic, limited access to the necessary PPE has been reported globally [9, 10, 11]. In Nigeria, access to PPE is also said to be a challenge at various levels of healthcare delivery [12]. This is very important especially with an increased rate of community transmission of the disease.

Therefore, adequate protection of the health workforce is paramount in the response to the outbreak. Apart from the needed motivation of HCW in the pandemic response through adequate welfare and social security, there is a crucial need to provide the required PPE with adequate training on IPC as it relates to the COVID-19. With the increasing trend of community transmission of the SARS-CoV-2 infection in Nigeria, it has become very necessary for all cadres of health workers to maintain Universal Safety Precaution at different levels of healthcare delivery. This study, therefore, aimed to investigate the access to and self-reported use of Personal Protective Equipment among healthcare workers (HCW) in Nigeria during the 2020 COVID-19 pandemic. The information generated will help to strengthen the outbreaks public health response.

2. Materials and methods

2.1. Study design

We conducted a mixed-method study which included a cross-sectional descriptive study using an adapted questionnaire delivered through online social media platforms as well as a qualitative in-depth interview with HCW to explore their perspective of access, use, and concern with PPE in the COVID-19 response.

2.2. Quantitative study

The Study population included different cadres of HCW working in multiple institutions at different levels of health service delivery in Nigeria.

2.2.1. Study instrument

The study made use of a pretested online questionnaire adapted from multiple sources which was sent to HCW through social media platforms. The questionnaire had four parts. Part one assessed the socio-demographic and clinical characteristics of respondents and basic information about their health facility; Part two assessed respondents' knowledge of COVID-19; Part three assessed the attitude of respondents to PPE use. The attitude was scored with respondents who scored above the median attitude score (27 IQR 8) adjudged to have a positive attitude and those that scored below the median score had a negative attitude. The fourth part of the questionnaire assessed the behaviour/practice of respondents towards PPE use in their facilities.

2.2.2. Data analysis

Data analysis was done using IBM SPSS version 26. Discrete variables are presented as percentages while continuous variables were expressed as means (\pm standard deviation). Proportions were compared using Pearson Chi-square, fishers exact for categorical variables. The level of significance was predetermined at $p < 0.05$. Association between the demographic, and clinical characteristics of respondents and access to

PPE at their facilities were assessed. Results are expressed as odds ratios with 95% confidence intervals.

2.3. Qualitative study

2.3.1. Design and sampling method. Qualitative study was carried out to further explore the study objectives. A purposive sampling method was employed to select the frontline HCW involved in the diagnosis and management of COVID-19 cases across Nigeria. Respondents were approached through a snowball technique and they work at different geopolitical zones of Nigeria. The Medical Laboratory Scientists interviewed were those involved in sample collection from suspected COVID-19 patients.

2.3.2. Data collection. In-depth interviews were conducted in the English language via telephone in a private room among 15 HCWs consisting of 5 Clinicians, 5 Nurses, and 5 Medical Laboratory Scientist. An Interview guide was used to obtain information on HCW's use of and access to PPE during the COVID-19 outbreak as well as to explore the facilitators and barriers of access to PPE among health workers.

2.3.3. Data analysis. The interviews were digitally recorded, and the recordings were transcribed verbatim and analysed using the thematic analysis to provide emerging themes.

2.4. Ethical consideration

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the Nigerian Institute of Medical Research. Respondents were given information about the study and that their participation was voluntary. A positive response by respondents to the question of willingness to complete the online questionnaire and to be interviewed was taken as consent to participate in the study.

3. Results

3.1. Quantitative study

Eight hundred and one HCWs were reached through various online social platforms (Facebook, Instagram, WhatsApp, etc.) across Nigeria but only 258 consented and completed the survey giving a response rate of 32.2%.

The majority (45.5%) of respondents were in the age group 35–44 years (mean age was 40.5 ± 8.6 years), were female (67.4%), and married (83.3%). The distribution of HCW cadres among the respondents showed that 49% were Doctors, 21.1% were Nurses, and 29.9% were other allied health workers. The Majority (66.2%) of the health workers had at least 10 years of practice experience and most of them (88.8%) work in government facilities; 44.1% work at Primary Healthcare facility, 24.5% work at Secondary Healthcare facility and 31.4% work at Tertiary Healthcare facility respectively. The majority of the respondents (41.0%) work in ≤ 50 -bed capacity hospitals while 20.9% work in outpatient clinics. Most of the respondents (87.4%) practice in the southwest geopolitical zone of Nigeria (Table 1).

Ninety-five percent of the health workers interviewed submitted that they have adequate knowledge of COVID-19 disease and 96.9% could correctly identify PPE needed for COVID-19 response. All participants have good knowledge of hand washing as a non-pharmaceutical intervention to COVID-19, and 95.7% and 99.2% knew when to use goggle/face shield and facemask during patient care respectively (Table 2).

Assessment of the attitude of respondents revealed that 55.3% strongly agreed that they are confident of their understanding of the risks that COVID-19 poses for patients and health workers. In addition, the majority (87.5%) of the respondents were confident they understood how to protect themselves and their patients during the outbreak. A similarly high proportion (89.5%) either agreed or strongly agreed that

Table 1. Socio-demographic Characteristics of respondents (n = 258).

Variable	Number	Percentage
Age (Years) (n = 253)		
<35	58	22.9
35-44	115	45.5
45-54	63	24.9
55-64	17	6.7
Mean Age (Years) - 40.5 SD 8.6		
Gender		
Female	174	67.4
Male	84	32.6
Marital Status		
Married	215	83.3
Single	35	13.6
Widowed	3	1.2
Divorced/Separated	5	1.9
Educational Status		
Secondary	1	0.4
Tertiary	255	98.8
Missing	2	0.8
Profession (n = 253)		
Doctor	124	49.0
Nurses	56	22.1
Laboratory Scientist	43	17.0
Pharmacist	5	2.0
CHEW/CHO	12	4.7
Physiotherapist	3	1.2
Others	10	4.0
Years of professional experience (years) (n = 246)		
<5	45	18.3
6-10	66	26.8
11-20	97	39.4
21-30	35	14.2
>30	13	5.3
Median years of professional experience - 12 [Range 1–37] IQR -13		
Type of facility		
Government	224	86.8
Private	34	13.2
Type of Government health facility (n = 229)		
Primary	101	44.1
Secondary	56	24.5
Tertiary	72	31.4
Number of hospital bed at the facility (n = 249)		
1-50	102	41.0
51-99	18	7.2
100-150	22	8.8
151-199	8	3.2
200-250	11	4.4
251-300	7	2.8
≥300	29	11.6
No admission facility	52	20.9
Geopolitical Zone (n=253)		
South West	221	87.4
Other regions	32	12.6

correct use of PPE would keep health workers from contracting the SARS-CoV-2 virus, though a lower proportion (61.7%) either agreed or strongly agreed that use of PPE will protect their patients from contracting the SARS-CoV-2 infection. About 19.7% of respondents felt that the use of different PPE could be inconvenient while 64.4% thought PPE use could interfere with patient care. However, 92.6% of the respondents either

agreed or strongly agreed that they could improve their compliance of the use of PPE during patient care at their facility (Table 2). Overall, 53.1% of the health workers had a positive attitude while 46.9% had a negative attitude to PPE use (Figure 1).

We also assessed respondents' access and self-reported use of PPE. Only 22.1% of the HCW submitted that PPE was readily available in their

Table 2. Knowledge and Attitude of Health workers to PPE.

Variable	Frequency	Percentage
I have adequate knowledge of COVID-19		
Yes	245	95
No	13	5
I can correctly identify a PPE		
Yes	250	96.9
No	8	3.1
I have correct knowledge of Hand Hygiene		
Yes	258	100
I know when to use goggles/face shield and gown during patient care		
Yes	247	95.7
No	10	3.9
I know when to wear face mask during patient care		
Yes	256	99.2
No	2	0.8
Attitude to COVID-19		
I am confident I understand the risks of COVID-19 for patients and HCW		
Strongly agree	142	55.3
Agree	87	33.9
Neutral	7	2.7
Disagree	2	0.8
Strongly disagree	19	7.4
I am confident I know how to protect myself and my patients		
Strongly agree	101	39.1
Agree	125	48.4
Neutral	18	7.0
Disagree	0	0
Strongly disagree	14	5.4
I am confident that use of PPE will keep HCW from COVID-19 infection		
Strongly agree	112	43.6
Agree	118	45.9
Neutral	8	3.1
Disagree	4	1.6
Strongly disagree	15	5.8
I am confident that use of PPE will protect patients from COVID-19		
Strongly agree	83	32.2
Agree	76	29.5
Neutral	53	20.5
Disagree	22	8.5
Strongly disagree	24	9.3
The use of PPE could be inconvenient (n = 258)		
Strongly agree	29	11.2
Agree	22	8.5
Neutral	30	11.6
Disagree	99	38.4
Strongly disagree	78	30.2
The use of PPE could interfere with patient care (n = 256)		
Strongly agree	106	41.4
Agree	59	23.0
Neutral	34	13.3
Disagree	33	12.9
Strongly disagree	24	9.4
I am confident that I can improve my PPE use compliance		
Strongly agree	148	57.8
Agree	89	34.8
Neutral	12	4.7
Disagree	5	2.0
Strongly disagree	2	0.8

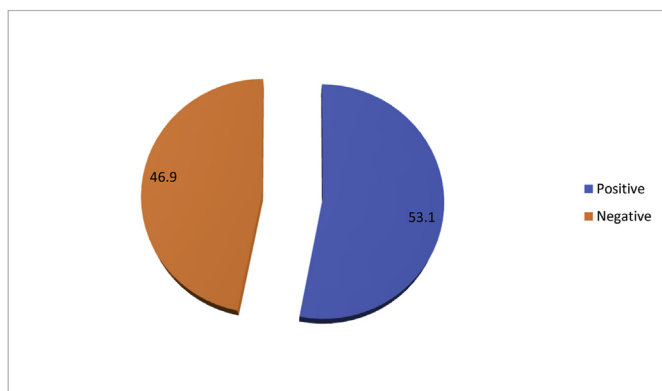


Figure 1. Overall attitude score.

facilities. Also, 44.9% of respondents alluded to the existence of PPE use compliance/monitoring at their health facility. However, 24.4% reported that their colleagues often forgot to use appropriate PPE during patient care. Assessment of practice of removal of PPE revealed that 65.1% would remove their PPE immediately after leaving the patients' admission area and 69.8% of respondents were confident, they understood the correct method of doffing PPE (Table 3).

Fewer HCW (34.3%) personally knew persons who had contracted the COVID-19 disease since the onset of the outbreak in Nigeria and only 26.4% felt currently protected and safe from the risk of contracting the SARS-CoV-2 infection. The infection control practices necessary to prevent droplets infection reported by the respondents were: wearing latex glove (83.1%), wearing a respirator (N-95 facemask) (83.1%), wearing surgical facemask (70.6%), and isolating the patients in a negative pressure room (55.2). Also, the respondents reported that the action necessary in caring for patients with suspected COVID-19 disease in a health care setting should include consult the institution infection control committee (84%), provide patients with a surgical facemask (81.6%), HCW should wear a face mask (77.3%), and gown and gloves to escort the patients to isolation centers (61.7%) (Table 3).

An assessment of the availability of different types of PPE and infection control and prevention modalities at the respondent's health facility revealed that only 20.6% and 28% had respirators (N-95 facemask) and face shield respectively. However, a significant proportion had access to soap and running water (91.1%), hand sanitizer (88.7%), latex gloves (89.1%), surgical facemasks (79.4%), and disinfection products (79%) while 44% and 40.5% of respondents had access to gowns and goggles respectively (Figure 2). Further analysis of the availability of different PPE necessary for COVID-19 response is as shown in Figure 3 in which about 95% of the facilities reported that they had none, or almost running out or running a bit low on availability of respirators in their facility.

An evaluation of the association between the socio-demographic characteristics of the health workers and their access to Respirators in their facilities revealed that health workers who are male and who work at either secondary or tertiary healthcare facility had better access to N-95 (p-value 0.025 and 0.010 respectively). However, the age of the health worker, years of experience, the cadre of the health workers had no significant association with their access to N-95 facemask (Table 4).

3.2. Qualitative study

3.2.1. Participants background information

Fifteen (15) HCW took part in the In-depth interview. Nine were females while 6 Males with age range 31–52 years and the minimum qualification for the respondents was a BSc (Graduate level). Most of the

respondents had practiced between 8 and 27 years and they comprised of Clinicians, Nurses, and Medical Laboratory Scientists (Table 5).

3.2.2. Use of PPEs

All the respondents interviewed stated that they had some knowledge of the use of PPEs and had been trained on the use of the different types of PPEs.

According to respondent 5,

“I have been trained on the use of PPEs and as a master trainer, I go to facilities and schools to train others”.

On the other hand, according to respondent 14,

“I have been working in my facility for over 5 years and I have not had an opportunity to attend a training on the use of PPEs, I just know how to use it from what I was taught in school and constant practice”.

However, the majority believed that there was a need for continuous training to update their skills in donning and doffing PPEs and other infection control practices.

Another respondent also stated that when staff goes for training, it is difficult for them to come back to the facility to conduct step-down training and that training, and retraining in order to improve staff knowledge and skills for PPE use is necessary.

3.2.3. Access to PPEs

Few respondents stated that they had to purchase face masks, gloves, and hand sanitizers for personal use because it was not available in their facility. The majority of the respondents had access to basic PPEs such as facemasks, gloves, and hand sanitizers. Thirteen respondents stated that they did not have access to surgical masks, N95, protective outfits in their facilities. Availability and access to PPEs differed based on facilities and based on whether PPE was provided weekly or monthly. A respondent stated,

“I do not have problems with getting PPEs, when I need, I go to the store manager who provides them on a bi-weekly basis”.

On the other hand, another respondent describes some challenges faced by HCW at their facility in getting access to PPE,

“it is difficult to get PPEs when they are available, they keep on telling us that they don't have, it is as if I need it for my personal use and this is upsetting so I do not ask any more”.

3.2.4. Level of training on the use of PPEs

The majority of the respondents had basic training on the use of PPEs, and they rated their knowledge at about 60%. They believe that continuous training will improve their knowledge and skill in the use of PPEs. According to respondent 4,

“There is the need to continuously train staff on the use of PPEs instead of assuming that they know how to use it, it should be part of the hospitals' mandate and yearly activities”.

3.2.5. Use of PPEs before COVID-19 and post lockdown

Six respondents rated the use of PPEs before COVID-19 at 42% and during the COVID-19 phase/lockdown at 90%. Three of the respondents rated the use of PPEs before COVID-19 at 30% and during the COVID-19 phase/lockdown at 65%. Four of the respondents rated the use of PPEs before COVID-19 at 35% and during the COVID-19 phase/lockdown at 85%. Two of the respondents stated that nothing had changed in their facility as the rate before and after the COVID-19 phase/lockdown was 40%.

Table 3. Respondents Access and self-reported use of PPE during 2020 COVID-19 outbreak.

Variable	Frequency	Percent
PPE is readily available in my Institution		
Yes	57	22.1
No	143	55.4
Maybe	57	22.1
I would be reprimanded by a supervisor if I did not use PPE		
Strongly agree	30	11.6
Agree	86	33.3
Neutral	68	24.6
Disagree	45	17.4
Strongly disagree	28	10.9
My colleague often forgot to use PPE during patient care		
Strongly agree	8	3.1
Agree	55	21.3
Neutral	49	19.0
Disagree	105	40.7
Strongly disagree	39	15.1
I would remove PPE immediately after leaving a patient's admission area		
Yes	168	65.1
No	52	20.2
Maybe	35	13.6
I am confident of the method of doffing my PPE		
Yes	180	69.8
No	76	29.5
I personally know anyone who has contacted COVID-19 during this outbreak? (n = 251)		
Yes	86	34.3
No	165	65.7
Extent of feeling of safety from contacting the COVID-19 disease.		
Very protected	68	26.4
Somewhat protected	119	46.1
Not sure	54	20.9
Somewhat unprotected	9	3.5
Very unprotected	8	3.1
Control practices necessary to avoid contracting an infection transmitted through droplet means.		
Isolating patients in negative pressure room	141 (of 255)	55.2
Wearing surgical facemask	180 (of 255)	70.6
Wearing N-95 when performing aerosol procedure	212 (of 255)	83.1
Wearing latex gloves	186 (of 255)	83.1
Hand hygiene	2 (of 255)	0.8
Wearing goggle	2 (of 255)	0.8
Action necessary in caring for a patient with possible COVID -19 infection		
Apply surgical mask	198 (of 256)	77.3
Provide patient with surgical mask	209 (of 256)	81.6
Consult the institution infection control committee	215 (of 256)	84.0
Wear a gown and glove and escort the patient	158 (of 256)	61.7
I don't know	3 (of 256)	1.2

3.3. Enablers of the use of PPEs

Some of the respondents reported that due to the scare, transmission rate, and route of COVID-19 transmission, their hospital management ensured that basic PPEs were provided to frontline HCWs. Also, in some instances, Government, Corporate bodies, and some private Organizations donated funds and PPEs to augment its availability. This they reported provided some form of relief, confidence, and security to the frontline HCW. According to respondent 11,

“I thank God for individual donors, Private organizations, and the government who heard our cry and understood our plight, I am not sure how we would have coped in these times”.

3.4. Barriers to the use of PPEs

There was limited supply of basic PPEs available for staff in the various facilities and in some situations HCW had to purchase them for their personal use. Fourteen respondents stated that with the onset of COVID-19, their facilities rallied round to get some PPEs and provided this to frontline HCWs because of the fear of transmission of the SARS-CoV-2. Also, due to the limited availability of requisite PPEs, only the frontline workers were given PPEs and the facilities could not provide facemasks, gloves to other allied health workers. However, in all the facilities, running water was provided via installed taps and soaps for hand washing.

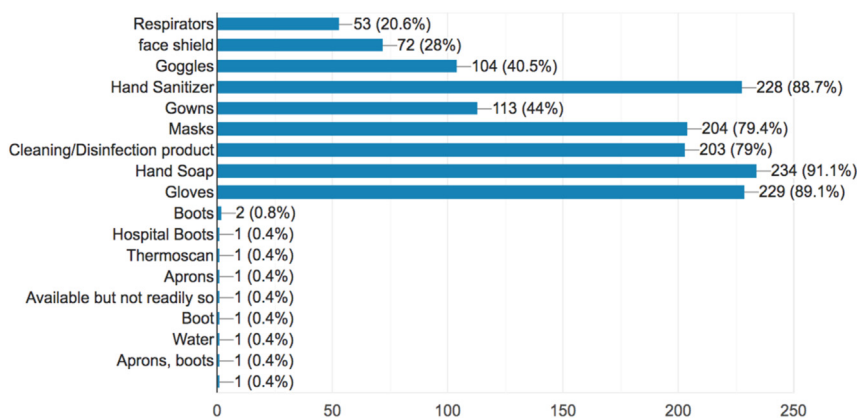


Figure 2. Availability of Personal Protective Equipment in Health facilities where the respondents work.

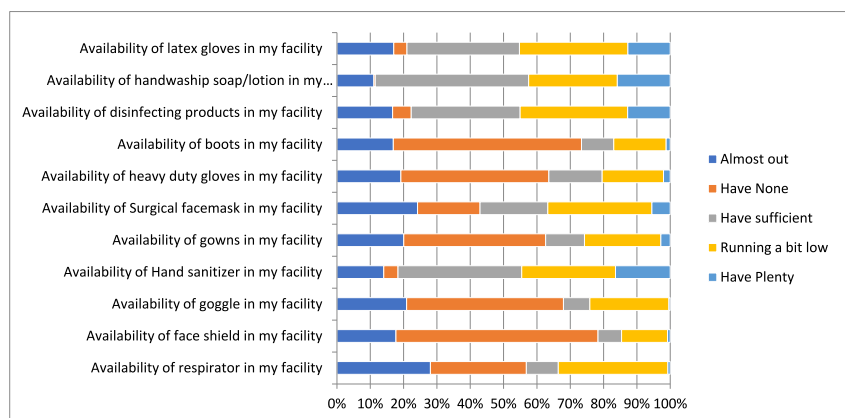


Figure 3. Respondents report of the availability of specific PPE at their facilities.

Table 4. Association between socio-demographic variables of respondents and access.

Variable	Respirator available		OR (CI)	p- value
	No	Yes		
Age (years)				
<40	90 (79.6)	23 (20.4)	0.98 (0.516–1.856)	0.924
≥40	96 (80.0)	24 (20.0)		
Sex				
Female	136 (84.0)	26 (16.0)	2.13 (1.113–4.080)	0.033*
Male	54 (71.1)	22 (28.9)		
Years of practice				
<10	57 (78.1)	16 (21.9)	0.87 (0.443–1.711)	0.728
≥10	131 (80.4)	32 (19.6)		
Health worker profession				
Other allied workers	100 (84.0)	18 (16.0)	1.75 (0.920–3.347)	0.106
Doctors	87 (75.0)	29 (25)		
Type of Facility				
Government	166 (79.8)	42 (20.2)		
Private	24 (80.0)	6 (20)	0.99 (0.380–2.572)	0.827
Level of Care for Government facilities				
Primary	86 (87.8)	12 (12.2)		
Secondary/Tertiary	84 (73.0)	31 (27.0)	2.65 (1.273–5.494)	0.013*

Table 5. Socio-demographic characteristics of the qualitative study participants.

Respondent	Gender	Age (yrs.)	Occupation	Years of Practice	Religion	Geopolitical zone of practice
1.	M	30	Clinician	8	Christian	North Central
2.	F	48	Clinician	20	Christian	South West
3.	F	45	Clinician	20	Christian	South West
4.	M	11	Clinician	11	Christian	South West
5.	F	10	Clinician	10	Christian	North West
6.	F	24	Nurse	47	Muslim	South West
7.	M	43	Med. Laboratory Scientist	14	Muslim	North East
8.	F	54	Med. Laboratory Scientist	27	Christian	South East
9.	M	45	Med. Laboratory Scientist	14	Muslim	North West
10.	M	40	Med. Laboratory Scientist	9	Muslim	South West
11.	F	52	Nurse	29	Christian	South West
12.	F	31	Nurse	10	Christian	South West
13.	M	33	Med. Laboratory Scientist	7	Christian	South West
14.	F	39	Nurse	12	Christian	South West
15.	F	42	Nurse	15	Christian	South West

According to respondents 7 and 12 the pandemic revealed some of the challenges with infrastructure available for service delivery at their facilities,

“the pandemic has exposed the infrastructural and operational deficit in various health facilities, and we hope that these loopholes will be breached by the provision of the necessary interventions and structures desperately needed at the facilities for standard practice”.

3.5. Enforcing safety measures at the health facilities

All frontline HCWs interviewed stated that they ensured that other members of staff who came to work obeyed the Infection Control guideline such as washing their hands, maintaining social distance, using their facemasks and/or gloves where applicable as well as hand sanitizers.

In all their facilities, there was “No Mask. No Entry” rules for all patients to reduce contact and transmission of the virus. However, this differed with regard to location and cultural practices. A respondent stated

‘When we told some patients to wear their facemasks before coming into the hospital, they threatened us with weapons, we were scared for our lives’.

Respondent 8 stated that

“it was difficult to enforce rules, a majority of the residents in this hospital did not believe that COVID-19 exists so it was a ‘tall order’ convincing them to obey safety precaution”

Some respondents stated that about half of the patients who came to the hospital during the period will conceal any symptoms linked to COVID-19 in order to access care in the hospital and this made it difficult for frontline workers to triage the patients for infection control. According to a respondent, “dealing with patients was very difficult because they will not tell you the truth about their symptoms and we feared for our lives so we had to be extra careful and hope that God will see us through”.

4. Discussion

The online survey assessed the self-reported use and access of health workers to personal protective equipment during the COVID-19 pandemic in Nigeria. A significant proportion of respondents had limited access to

PPE that is necessary to protect against the spread of airborne infection through droplets and aerosol [13] in their health facilities.

Our study revealed a below-average response rate from health workers contacted for the online survey. This could be due to the attitude of health workers in Nigeria and elsewhere to the online questionnaire survey and also because of their busy work schedule. This is corroborated by previous studies that reported a response rate that was as low as 23% to an online survey among HCW [14, 15]. The mean age of the respondents was 40 years and the majority of the respondents had over 10 years of experience, which suggests that most were mid-career health workers with some managerial duties and should be able to provide an adequate assessment of the health facilities where they work. There were more medical doctors than other health workers among the respondents in the quantitative study. This finding is similar to the report of the preponderance of physicians in a Latin American study of personal safety during the COVID-19 pandemic [9]. Another online study that assessed the use of PPE among health care workers in the NHS in the United Kingdom also reported a higher proportion of medical doctors in their survey [16].

Health care workers in the study appeared to be well informed about the COVID-19 disease and its associated high infectivity because a significant proportion of them could correctly recognize the different categories of PPE needed for infection control in healthcare settings. This could be because a sizable proportion of the respondents' practice in Lagos state which is a metropolitan area in Nigeria, and it could also be a direct result of the level of awareness about the COVID-19 disease through active media engagement of the Federal Government of Nigeria through the NCDC and State's Ministries of Health containment and epidemiological response to the COVID-19 pandemic. Also, there was an indication that the practice of ‘handwashing’ that was initially adopted in the country during the 2014 Ebola virus disease outbreak is being reinforced in the current outbreak response as all participants understood and practiced regular hand washing as a means of infection prevention and control in their facilities. This is similar to other Nigerian studies [17] on the importance of handwashing in IPC of communicable diseases. Hand hygiene has also been described as an important means of preventing COVID-19 disease in healthcare settings and in the community [18]. It is also of note that hand hygiene is an important basic hygiene tool in the infection prevention and control of infectious diseases.

In this study, a significant proportion of respondents expressed a disturbing concern that PPE could interfere with patient care. A lower percentage also reported that using PPE could be inconvenient. These views could invariably affect their regular and correct use of PPE. There is therefore a need to sustain training and awareness creation among

health workers on PPE use. However, a significant proportion of the respondents had a positive attitude to PPE use, which is encouraging.

Assessment of the availability of various types of PPE at health facilities where respondents work shows that PPE is not readily available in many of the facilities and in some instances, HCW have to procure PPE for their personal use. Just as some of the participants in the qualitative reported incidence of possible hoarding of PPE by the hospital management. This finding is similar to previously reported limited access to PPE in Nigeria [19] and also from different settings since the onset of the COVID-19 pandemic [8, 16]. A study of the NHS reported that PPE was inadequate and many front-line HCWs were infected possibly due to lack of access to PPE [20]. This inadequate access to PPE was also reported in a similar study from Latin American [9]. The availability of organizational or administrative measures to ensure compliance with PPE use is below average in our study, which suggests a need for institutionalization and enforcement of infection control policy at different facilities [21].

In addition, about 69.8 % of the health workers knew when and how to doff their PPE which suggests the need to further strengthen the capacities of the health care workers in Nigeria through training and awareness creation for an appropriate response to the COVID-19 outbreak. Training for health workers on the effective ways of donning and doffing PPE has been recommended and reported to limit highly infectious viral pathogens in healthcare settings [22, 23, 24].

The HCW interviewed demonstrated an adequate understanding of some of the infection control practices limiting the transmission of diseases caused by droplet infections in healthcare settings. This could have some relationship with the comparatively low mortality among front line HCW in the current COVID-19 pandemic response in Nigeria. However, there is a need to further evaluate the association between the use of PPE and the risk of transmission of COVID-19 in health care settings. An assessment of the availability of PPE to prevent the potential transmission of infective agents through droplets and aerosol revealed that many health care workers had limited access to Respirator and Face Shield as well as protective Gowns and Goggles in healthcare settings though there is documented access to more basic PPE like Surgical Facemask and Latex Gloves. This finding could be the reason why many of the respondents expressed the concern that “they do not feel adequately protected to provide care to persons suspected to have COVID-19 disease”. The report of lack of PPE is not peculiar to the settings reported in this study as previously documented. However, there is a need to explore innovative ways of ensuring access to the N-95 facemask as reported in other settings. Some of the innovative ways of ensuring access to respirator previously reported include (1) disinfection with highly energetic short-wave ultraviolet germicidal radiation at 254nm [24], (2) vaporous hydrogen peroxide (VHP), and (3) moist heat [22]. However, the practice of disinfection before reuse could not be ascertained among the respondents in this study. Further studies would be important to explore methods used by HCW to navigate the challenge posed by lack of PPE during COVID-19 pandemic in Nigeria.

The Availability of PPE to prevent the potential transmission of the infective agent through droplets and aerosol (respirators) to HCW could be used as surrogates to assess the level of preparedness for infection control and prevention of a potentially highly contagious pathogen like the SARS-CoV-2 infection. Evaluation of factors associated with access to this PPE (N-95 facemask) in our study revealed that male health workers and health workers who work in secondary and tertiary health facilities had better access. This could be because the majority of nurses and other allied health workers in our environment are female. Therefore, male health workers who are likely to be doctors with a measure of administrative responsibility have better access when compared to other health workers. Also, it stands to reason that as expected, health workers in secondary and tertiary health facilities would have access to N-95 facemask because they are most likely to be working in a bigger health facility with provision for inpatient care and hence likely to manage severe illnesses. However, there is an equal need to adequately protect health workers at the primary health care facilities who are likely to be the first

line of care to manage ‘community transmission’ of potentially infectious agents in the community.

Some of the limitations of this study are the low response rate among the HCW, which is expected as a common challenge with online surveys. Again, the study was not designed for hypothesis testing but mainly to generate descriptive information on the self-reported use and access to PPE in healthcare settings hence study power consideration is not a priority. Also, participants were recruited mainly based on their willingness to participate in an online survey through social media platforms and their willingness to be interviewed, therefore health workers who are not on social media and those who could not be reached via telephone for the in-depth interview could not participate in the study and this could limit the generalizability of the study findings. However, with the restriction of movement due to efforts at containment of the COVID-19 pandemic, there is a global migratory tendency to online or remote research, webinars, and meetings that this study also explored.

5. Conclusions

As Nigeria continues to respond to the COVID-19 pandemic, the protection of front-line health workers is a priority. In this study, we reported limited access to essential personal protective equipment in health care settings. Though health workers in the study have adequate understanding and adoption of hand washing as a means of infection control and prevention in a health care setting, their knowledge of and appropriate use of PPE needs to be reinforced. There is also an urgent need to provide the necessary PPE in healthcare settings through an innovative approach as well as the need to ensure that there are adequate infection prevention and control policy and its enforcement at the facility level. Also, there will be need for further studies to evaluate the association between the use of PPE and the risk of transmission of COVID-19 in health care settings.

Declarations

Author contribution statement

David Ayoola Oladele: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Ifeoma Eugenia Idigbe: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data.

Agatha David, Oluwagbemiga Aina, Nkiruka Odunukwe and Babatunde Lawal Salako: Conceived and designed the experiments; Wrote the paper.

Oliver Ezechi: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Adesola Zaidat Musa: Performed the experiments; Analyzed and interpreted the data.

Abideen Salako: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Tosin Odubela: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Aigbe Gregory Ohihoin and Titilola Gbaja-Biamila, Tajudeen Bami-dele and Esther Ohihoin: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at <https://doi.org/10.1016/j.heliyon.2021.e07100>.

Acknowledgements

We acknowledge the Nigerian HCW who participated in this study and our friends who assisted in distributing the questionnaire through the social media platforms.

References

- [1] World Health Organization [Internet], Coronavirus disease 2019 (COVID-19) Situation Report – 98, 2020, April 27 [cited 2020 Oct 15]; Available from: <https://www.who.int/docs/default-source/coronavirus/situation-reports/2020-04-27-sitrep-98-covid-19.pdf>.
- [2] World Health Organization [Internet], Rolling updates on coronavirus disease (COVID-19), 2020, July 31 [Cited 2020 Oct 15]; Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.
- [3] World Health Organization [Internet]. Official Coronavirus Updates [Cited 2020 Oct 15]; Available from: www.who.int/covid-19/information.
- [4] Africa CDC [Internet], Latest updates on the COVID-19 crisis from Africa CDC, 2020, November 10 [Cited 2020 Nov 10]; Available from: <https://africacdc.org/covid-19/>.
- [5] Nigerian Centre for Disease Control [Internet], An update of COVID-19 outbreak in Nigeria, 2020, November 10 [Cited 2020 Nov 10]; Available from: [https://ncdc.gov.ng/diseases/sitreps/?cat=14&name=An update of 20COVID-19 outbreak in Nigeria](https://ncdc.gov.ng/diseases/sitreps/?cat=14&name=An%20update%20of%20COVID-19%20outbreak%20in%20Nigeria).
- [6] F. Chirico, G. Nucera, N. Magnavita, COVID-19: protecting Healthcare Workers is a priority [published online ahead of print, 2020 Apr 17], *Infect. Control Hosp. Epidemiol.* (2020) 1–4.
- [7] Amnesty International [Internet], Global: Amnesty analysis reveals over 7,000 health workers have died from COVID 19, 2020, September 3 [Cited 2020 Nov 10]; Available, <https://www.amnesty.org/en/latest/news/2020/09/amnesty-analysis-7000-health-workers-have-died-from-covid19/>.
- [8] D. Delgado, F. Wyss Quintana, G. Perez, et al., Personal safety during the COVID-19 pandemic: realities and perspectives of healthcare workers in Latin America, *Int. J. Environ. Res. Publ. Health* 17 (8) (2020) 2798. Published 2020 Apr 18.
- [9] M.T. Hirschmann, A. Hart, J. Henckel, P. Sadoghi, R. Seil, C. Mouton, COVID-19 coronavirus: recommended personal protective equipment for the orthopaedic and trauma surgeon, *Knee Surg. Sports Traumatol. Arthrosc.* 28 (6) (2020) 1690–1698.
- [10] N.J. Rowan, J.G. Laffey, Challenges and solutions for addressing critical shortage of supply chain for personal and protective equipment (PPE) arising from Coronavirus disease (COVID19) pandemic - case study from the Republic of Ireland, *Sci. Total Environ.* 725 (2020) 138532.
- [11] World health Organization [Internet], WHO calls for healthy, safe and decent working conditions for all health workers, amidst COVID-19 pandemic, 2020, April 28 [Cited 2020 Nov 10]; Available from: <https://www.who.int/news-room/detail/28-04-2020-who-calls-for-healthy-safe-and-decent-working-conditions-for-all-health-workers-amidst-covid-19-pandemic>.
- [12] T.M. Cook, Personal protective equipment during the coronavirus disease (COVID) 2019 pandemic - a narrative review, *Anaesthesia* 75 (7) (2020) 920–927.
- [13] A.E. Arafa, F. Anzengruber, A.M. Mostafa, A.A. Navarini, Perspectives of online surveys in dermatology, *J. Eur. Acad. Dermatol. Venereol.* 33 (3) (2019) 511–520.
- [14] S.W. Ong, M.A. Hassali, F. Saleem, Community pharmacists' perceptions towards online health information in Kuala Lumpur, Malaysia, *Pharm. Pract.* 16 (2) (2018 Apr-Jun) 1166.
- [15] M.R. Iqbal, A. Chaudhuri, COVID-19: results of a national survey of United Kingdom healthcare professionals' perceptions of current management strategy - a cross-sectional questionnaire study, *Int. J. Surg.* 79 (2020) 156–161 [published online ahead of print, 2020 May 21].
- [16] R.I. Ejemot-Nwadiaro, J.E. Ehiri, D. Arikpo, M.M. Meremikwu, J.A. Critchley, Hand washing promotion for preventing diarrhoea, *Cochrane Database Syst. Rev.* 2015 (9) (2015) CD004265. Published 2015 Sep 3.
- [17] R. Güner, I. Hasanoglu, F. Aktaş, COVID-19: prevention and control measures in community, *Turk. J. Med. Sci.* 50 (SI-1) (2020) 571–577. Published 2020 Apr 21.
- [18] Dimie Ogoina, COVID-19: the need for rational use of face masks in Nigeria 2020, *Am. J. Trop. Med. Hyg.* (2020) 1–2.
- [19] J.P. Thomas, A. Srinivasan, C.S. Wickramarachchi, P.K. Dhesi, Y.M. Hung, A.V. Kamath, Evaluating the national PPE guidance for NHS healthcare workers during the COVID-19 pandemic, *Clin Med (Lond)* (2020) [published online ahead of print, 2020 May 1], [clinmed.2020-0143](https://doi.org/10.1093/clinmed/cvz014).
- [20] S. Ambigapathy, G.S. Rajahram, U.K. Shamsudin, et al., How should front-line general practitioners use personal protective equipment (PPE)? *Malays. Fam. Physician* 15 (1) (2020) 2–5. Published 2020 Mar 18.
- [21] S. Lazzari, B. Allegranzi, E. Concia, Making hospitals safer: the need for a global strategy for infection control in health care settings, *World Hosp. Health Serv.* 40 (2) (2004) 32–39.
- [22] F. Umer, Z. Haji, K. Zafar, Role of respirators in controlling the spread of novel coronavirus (COVID-19) amongst dental healthcare providers: a review, *Int. Endod. J.* (2020) [published online ahead of print, 2020 May 1].
- [23] William A. Fischer II, et al., Personal protective equipment: protecting health care providers in an Ebola outbreak, *Clin. Therapeut.* 37 (2015) 2402–2410, 11.
- [24] I. Boškoski, C. Gallo, M.B. Wallace, G. Costamagna, COVID-19 pandemic and personal protective equipment shortage: protective efficacy comparing masks and scientific methods for respirator reuse, *Gastrointest. Endosc.* (2020) [published online ahead of print, 2020 Apr 27]. S0016-5107(20)34247-4.