Original Article

Infection prevention knowledge and practices among healthcare workers at a health facility in Makurdi, Benue State, Nigeria

OWOICHO OKO AMALI and RENAY HELOUISE VAN WYK

Faculty of Health Sciences, Department of Environmental Health, University of Johannesburg, South Africa

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Abstract. The ongoing COVID-19 pandemic has highlighted the critical importance of infection prevention practices among healthcare workers. Prioritizing this crucial aspect of healthcare can mitigate the spread of infectious diseases and ensure the well-being of our healthcare heroes and their communities. The purpose of the research was to investigate the knowledge and practice of infection prevention and control. The study was a cross-sectional study that used self-administered paper-based questionnaires. The study sample of 316 eligible healthcare workers was selected using stratified sampling. Data was entered into EPI Info version 7.2 and exported to SPSS version 27 for analysis. The ethics committees of the university and the hospital approved the study. The majority of participants 116 (36.7%) were nurses. The mean age was 34.79 years ± 8.37, 118 (37.30%) were male while 198 (62.7%) were female. Only 169 (53.9%) knew the recommended duration for hand washing. 132 (41.8%) of healthcare workers believed needles should be recapped following use. Healthcare workers were twice as likely to wash their hands before contact and five times more likely to wash their hands after contact with a patient, their bedding, or after a procedure (AOR 1.82, 95% CI 1.04-3.20), (AOR 4.51, 95% CI 1.76-11.54) respectively. Personal protective equipment (PPEs) were twice as likely to be unavailable (AOR 2.39, 95% CI 1.31-4.37). The findings revealed suboptimal knowledge and practice of hand hygiene indicating the need for healthcare workers to be trained on Infection Prevention and Control. PPE(s) must be provided for healthcare workers to improve compliance with IPC practices.

Correspondence to: Renay Helouise Van Wyk, Faculty of Health Sciences, Department of Environmental Health, University of Johannesburg, South Africa
E-mail: renayvw@uj.ac.za

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Introduction

As frontline heroes, healthcare professionals are at higher risk of contracting and spreading infectious diseases putting themselves and their patients in danger. The consequences of inadequate infection prevention practices can be catastrophic leading to outbreaks within hospital and communities and threatening the overall effectiveness of healthcare systems.

Mankind has experienced multiple emergence and re-emergence of infectious disease outbreaks with a negative impact on global health. Examples of such outbreaks within the last two decades include Severe Acute Respiratory Syndrome (SARS-COV) in 2002, Influenza outbreak H1N1 in 2009, Middle East Respiratory Virus (MERS-Cov) in 2012, Ebola in 2013, and the Severe Acute Respiratory Syndrome (SARS Cov2) from 2019 till present (1). Human resources for health (HRH) challenges confront the Nigerian health system including inadequate production and distribution of health care workers such as doctors, nurses, and midwives whose numbers are insufficient to provide essential health services effectively (2).

Multiple disease outbreaks have occurred in Nigeria with the top emerging and re-emerging diseases being Lassa fever, Monkey Pox, Ebola virus disease, Yellow Fever, and Poliomyelitis. Between 2016 and 2018 alone there were over twenty (20) public health emergencies and infectious disease outbreaks each with five or more public health events or more annually (3). The severity and frequency of disease outbreaks pose a significant threat to the safety of healthcare workers, who should be aware that outbreaks can occur at any time and be vigilant in their work. To ensure the safety of both healthcare workers and their patients, it is essential to implement and enforce robust infection prevention protocols.

Objectives of the study. The objectives of the study were:

1) To describe the socio-demographic characteristics of healthcare workers at the health facility in Makurdi, Benue State, Nigeria.
2) To assess the level of knowledge of healthcare workers on infection prevention and control at the health facility in Makurdi, Benue State Nigeria.

3) To determine infection prevention and control practices among healthcare workers at a health facility in Makurdi, Benue State, Nigeria.
4) To determine the factors/reasons for non-adherence to standard precautions or infection control protocols and the use of personal protective equipment among healthcare workers at a health facility in Makurdi, Benue State, Nigeria.

The aim of the study was to investigate infection prevention and control practices among healthcare workers at a health faciity in Makurdi, Benue State Nigeria.

Materials and methods

Study design and setting. Doctors, nurses, midwives, dentists/dental technicians, laboratory scientists, auxiliary medical personnel, community health extension workers, and health attendants participated in the cross-sectional study. The study took place at a health center in Makurdi Benue state, Nigeria which has about 400 beds and operates eight different sites including annexes. It is a referral center for complex cases from all over the state. It employs about 1,004 health professionals including doctors, nurses/midwives, laboratory scientists, dentist and dental technicians, physiotherapists, health attendants, dentists, dental therapists, and others. The faculty higher degrees committee and the research ethics committee of the Faculty of Health Sciences at the University of Johannesburg granted approval for the study as well as the research ethics committee of the hospital.

Sample size calculation. Epi Info version 7.2 was used to calculate the sample size. With an estimated population of 1,004, an acceptable margin of error of 5% in one cluster, the estimated sample size at 95% confidence interval=278. The sample size will be 278+42=320 after adjusting for a non-response rate of 15%.

Data collection method. A team of trained research assistants distributed the pretested paper-based questionnaires to participants. Participants were selected using stratified sampling technique. Questions were close-ended, with four sections on sociodemographic information, knowledge of infection prevention and control, infection prevention and control practice, and factors influencing non-adherence to infection control protocols and the use of PPE(s). Each questionnaire took an average of 15-20 min to complete and return.

Reliability and validity. Employees who provided direct care or had direct contact with patients, such as examining patients, handling medical-related specimens or waste, or performing procedures on patients were included. Any staff not involved in direct care, or handling anything medically related, such as admin staff, human resource staff, or finance department staff as well as anyone under the age of 18 were excluded from the study as were infection prevention and control officers to avoid the possibility of some level of bias in response to some questions.

To ensure the reliability of the data collection instruments, relevant literature, and standardized tools were used, referencing those previously determined to be reliable. Previous literature on knowledge of infection control was used as a source (4-7). The questionnaires were also assessed for their appropriateness with the target population. To ensure the data collection instruments' optimal validity, references were made to relevant literature that had already been established to be valid, to measure knowledge, practice, and factors or reasons for non-adherence to infection prevention and control as well as the use of PPE(s). The questions were brief, logical, sequential, and self-explanatory and were designed to elicit all of the information required to answer the research questions. The instructions were clear and straight to the point.

Data analysis. The independent variables for the study were sociodemographic variables such as age, gender, years of experience, and level of education. The dependent variables were infection prevention and control knowledge, infection prevention, and control practice, and factors affecting non-adherence to infection prevention and control protocols and the use of PPE(s). The collected questionnaires were first checked for completeness, accuracy, correctness, and cleanliness. Data were coded to make entry into the statistics software easier and securely stored in a personal computer. Data was entered into Centers for Disease Control and Prevention's (CDC)'s EPI Info version 7.2 and exported to SPSS version 27 for analysis.

Ethical considerations. Approval for the study was obtained from the University of Johannesburg, Health Science Faculty of Higher Degrees Committee (FHDC) referenced MPH HDC 01-04-2021 and ethical clearance was granted by the Research Ethics Committee (REC) referenced REC 952-2021 as well as the Ethics committee of Federal Medical Center Makurdi FMH/FMC/HRE/01. Identifying study participants was part of the recruitment process. A study information letter was distributed to all participants informing them of the research's methods, purpose, risks, and benefits. It explained the duration and procedures for the interview, as well as the potential benefits to the individual and community and any risk involved. Informed consent was obtained from participants while maintaining ethical standards, and anonymity. Participants who agreed to participate signed a consent form voluntarily.

Results

A total of 316 health care workers participated in the study with a response rate of 98.7%.118 (37.3%) were male while 198 (62.70%) of them were female. The majority 116 (36.7%) were nurses. (Table I)

Overall, 310 (98.1%) participants had heard of infection prevention and control protocols while only 6 (1.9%) including 4 lab technicians,1 health attendant and a community health worker had never heard or know of the protocols with no training as well. 106 (33.5%) of those who knew about these protocols heard of them from sources other than those listed such as other health care providers, school, and through self learning and seminars, while 27 (8.5%) learned about them from journals. The results were significant for lack of knowledge on the minimum recommended duration for hand washing (AOR 0.32, 95% CI 0.19-0.54) relative to the actual recommended duration of 20 sec. It can be concluded that healthcare workers had 68% lower odds of knowing the minimum recommended

Table I. Distribution of sociodemographic characteristics of participants.

Characteristics	Male		Female		Total	
	n	%	n	%	n	%
	118	37.30	198	62.70	316	100
Age						
18-19	1	20.00	4	80.00	5	1.60
20-29	9	23.70	29	76.30	38	12.00
30-39	34	35.10	63	64.90	97	30.70
40-49	48	42.10	66	57.90	114	36.10
50 and above	26	41.90	36	58.10	62	19.60
Profession						
Medical Doctor	49	72.10	19	27.90	68	21.50
Nurse/Midwife	17	14.70	99	85.30	116	36.70
Laboratory Scientist	26	66.70	13	33.30	39	12.30
Auxiliary Medical Staff/Health Technicians/Community	17	37.80	28	62.20	45	14.20
Health Extension workers						
Health Attendants	9	20.50	35	79.50	44	13.90
Dentist/Dental Therapist	0	0.00	4	100	4	1.30
Work Experience						
<6 months	5	45.50	6	54.50	11	3.50
6-12 months	15	46.90	17	53.10	32	10.10
12-24 months	10	27.80	26	72.20	36	11.40
>24 months	88	37.10	149	62.90	237	75
Highest Level of Education						
Primary	2	20	8	80	10	3.20
Secondary	7	19.40	29	80.60	36	11.40
Tertiary	73	38	119	62	192	60.80
Post Graduate	36	46.20	42	53.80	78	24.70

duration for hand washing.132 (41.8%) health care workers believed needles should be recapped following use (Table II).

The findings were significant for those that sometimes washed their hands before contact with a patient, their beddings, materials, or the patient environment (AOR 1.82, 95% CI 1.04-3.20). This meant that healthcare workers were twice as likely to sometimes wash their hands before making contact. Nevertheless, the results were significant for those that sometimes washed their hands with soap and water after contact with a patient, their beddings, and patient's environment or after collecting blood samples (AOR 4.51, 95% CI 1.76-11.54). This indicates that healthcare workers were 5 times more likely to sometimes wash their hands after making contact (Table III).

The findings were significant for participants who had not been trained on infection prevention and control protocols (AOR 2.22, 95% CI 1.29-4.22). This meant that healthcare workers were twice as likely not to be trained on IPC protocols. The findings were significant for the non-availability of PPE(s), (AOR 2.39, 95% CI 1.31-4.37). This meant that PPEs were twice as likely to be unavailable.

The results for the doctor and head of the team not maintaining universal precautions were statistically significant (AOR 0.44, 95% CI 0.23-0.85). This implies that the doctor and team leader had 56% lower odds of maintaining universal precautions (Table IV).

Discussion

The background information of research participants was age, sex/gender, profession, level of education, and work experience. In this study, it was determined that most of the participants were within the 40-49 age group 114 (36.1%). This was feasible because the mid-level to senior-level professionals may fall into this age range. The findings contrasted with those of a different study in Ethiopia which revealed that the majority of participants were between the ages of 20-30 (8).

Nurse/midwives, 116 (36.7%) outnumbered the other professions, whereas the dentists/dental therapists, were four (1.3%) the least in number. This was possible because inpatient care and nursing care in health facilities require the necessary work force to cope with critical nursing care and may be responsible for the recruitment of the necessary number of nurses. Another study in northwest Nigeria found that the majority of participants were nurses by profession (4). Nonetheless, a different study found that doctors had the highest population

Table II. Knowledge on infection prevention and control.

Characteristics	Total		Male		Female		Crude Odds Ratio	95% CI*	Adjusted Odds ratio**	95% CI
	n	%	n	%	n	%				
	316	100	118	37.30	198	62.70				
Healthcare worker heard of IPC Protocols										
Yes	310	98.10	115	37.10	195	62.90	Ref	Ref	Ref	Ref
No	6	1.90	3	50	3	50	1.7	0.34-1.38	1.28	0.07-24.70
If yes what is the source of your information?										
TV/Radio	93	29.40	36	38.80	57	61.30	0.7	0.36-1.38	1.16	0.54-2.45
Internet	29	9.20	8	27.60	21	72.40	0.42	0.16-1.12	0.45	0.16-1.25
Journals	27	8.50	13	48.10	14	51.90	1.04	0.41-2.60	1.54	0.57-4.11
Others	106	33.50	32	30.20	74	69.80	0.48	0.25-0.94	0.6	0.29-1.22
More than one source	55	17.40	26	47.30	29	52.70	Ref	Ref	Ref	Ref
Not heard of IPC	6	1.90	3	50.00	3	50.00	1.11	0.21-6.02	0.95	0.05-18.67
Routine precautions encourage the use of gloves for only blood or body fluids										
True	114	36.10	44	38.60	70	61.40	1.1	0.68-1.75	1.02	0.60-1.72
False	202	63.90	74	36.60	128	63.40	Ref	Ref	Ref	Ref
Invasive procedures require hand washing with soap										
True	283	89.60	107	37.80	176	62.20	Ref	Ref	Ref	Ref
False	33	10.40	11	33.30	22	66.70	0.82	0.38-1.76	0.75	0.33-1.70
The minimum recommended duration for hand washing is										
15 secs	147	46.50	36	24.50	111	75.50	0.34	0.21-0.56	0.32	0.19-0.54
20 secs	169	53.50	82	48.50	87	51.50	Ref	Ref	Ref	Ref
The use of gloves can stand in for hand washing										
True	89	28.20	31	34.80	58	65.20	0.86	0.52-1.43	0.98	0.53-1.84
False	227	71.80	87	38.30	140	61.70	Ref	Ref	Ref	Ref
Isolation rooms are still used for diseases that are potentially airborne such as TB?										
True	276	87.30	102	37.00	174	63.00	Ref	Ref	Ref	Ref
False	40	12.20	16	40.00	24	60.00	1.13	0.58-2.24	1	0.47-2.12
Needles should be recapped following use										
True	132	41.80	50	37.90	82	62.10	1.04	0.65-1.65	1.22	0.69-2.13
False	184	58.20	68	37.00	116	63.00	Ref	Ref	Ref	Ref
Capped needles should be put in a bin or garbage										
True	160	50.60	58	36.30	102	63.80	0.91	0.58-1.44	1.02	0.57-1.84
False	156	49.40	60	38.50	96	61.50	Ref	Ref	Ref	Ref
The hospital environment is a major source of spread of infectious diseases										
True	248	78.50	97	39.10	151	60.90	Ref	Ref	Ref	Ref
False	68	21.50	21	30.90	47	69.10	0.69	0.40-1.24	0.77	0.41-1.46

among participants followed by nurses, physiotherapists, laboratory scientists/technicians, and community health extension workers (9).

The findings from the study also revealed that 106 (33.5%) Healthcare workers got their information from other sources. This was possible because other sources may include sources that were not listed. A study found that healthcare providers (nurses, IPC practitioners, and hospital epidemiologists) were an important source of information on infection prevention and control that was not listed (10). This is also supported by another study, which identified self-learning as an important source of information on infection prevention and control in addition to the sources listed (11).

There was a statistically significant (AOR 0.32, 95% CI 0.25-0.94) lack of knowledge on the minimum recommended duration for hand washing. This was possible because while hand hygiene is an important measure of reducing infection spread, healthcare workers may not have all the necessary information available to them through training and workshops. The findings corroborate previous studies that found a knowledge gap in hand hygiene among health workers (4). This is possible because while healthcare workers are aware of the importance of hand hygiene, their knowledge of the

Table III. Practice of Infection prevention and control.

Characteristics	Total		Male		Female		Crude Odds Ratio	95% CI*	Adjusted Odds ratio**	95% CI
	n	%	n	%	n	%				
	316	100	118	37.30	198	62.70				
Do you wash your hands before contact with each Patient, Beddings or materials in the patient environment?										
Always	158	50	44	27.80	114	72.20	Ref	Ref	Ref	Ref
Sometimes	152	48.10	71	46.70	81	53.30	2.27	1.42-3.64	1.82	1.04-3.20
Never	6	1.90	3	50.00	3	50.00	2.59	0.50-13.33	2.94	0.53-16.26
Do you wash your hands with soap and water after contact with patient, beddings or materials or after taking blood sample?										
Always	280	88.60	91	32.50	189	67.50	Ref	Ref	Ref	Ref
Sometimes	36	11.40	27	75.00	9	25.00	6.23	2.81-13.80	4.51	1.76-11.54
Do you wash your hands immediately you come in contact with contaminated items, body fluid or Blood?										
Always	300	94.90	108	36.00	192	64.00	Ref	Ref	Ref	Ref
Sometimes	14	4.40	8	57.10	6	42.90	2.37	0.80-7.01	1.07	0.28-4.06
Never	2	0.60	2	100.00	0	0.00	1.56	0.32-39.67	Undefined	Undefined
Do you wash your hands after removing gloves? ***										
Always	257	81.30	88	34.20	169	65.80	Ref	Ref	Ref	Ref
Sometimes	58	18.40	29	50.00	29	50.00	1.92	1.08-3.42	1.24	0.61-2.51
Never	1	0.30	1	100.00	0	0.00	1.92	0.12-31.07	Undefined	Undefined
Do you wear gloves during procedures or task on a Patient, Bedding's, materials or environment?										
Always	245	77.50	87	35.50	158	64.50	Ref	Ref	Ref	Ref
Sometimes	66	20.90	30	45.50	36	54.50	1.51	0.87-2.62	0.87	0.50-1.50
Never	5	1.60	1	20.00	4	80.00	0.45	0.05-4.13	0.54	0.15-1.95
Do you wear protective eye googles, Aprons, or boots in Procedures with the potential of splashing blood, body fluid or waste material?										
Always	167	52.80	60	35.90	107	64.10	Ref	Ref	Ref	Ref
Sometimes	137	42.40	53	38.70	81	59.10	1.17	0.73-1.86	0.87	0.50-1.50
Never	15	4.70	5	33.30	10	66.70	1.3	0.43-4.44	0.54	0.15-1.95
Do you recap a needle before disposal?										
Always	127	40.20	46	36.20	81	63.80	1.12	0.64-1.96	1.17	0.64-2.16
Sometimes	97	30.70	41	42.30	56	57.70	1.44	0.80-2.60	1.26	0.66-2.41
Never	92	29.10	31	33.70	61	66.30	Ref	Ref	Ref	Ref
Do you discard sharp materials in safety box?										
Always	224	70.90	80	35.70	144	64.30	Ref	Ref	Ref	Ref
Sometimes	84	26.60	36	42.90	48	57.10	1.35	0.81-2.25	0.81	0.44-1.49
Never	8	2.50	2	25.00	6	75.00	2	0.12-3.04	0.16	0.02-1.51
Have you been fully vaccinated against Hepatitis B Virus?										
Yes	166	52.50	60	36.10	106	63.90	Ref	Ref	Ref	Ref
No	155	47.50	58	37.40	92	59.40	1.11	0.71-1.75	1.00	0.60-1.65

five moments of hand hygiene was lacking (12). Although in a separate study, the majority of the healthcare workers knew how to wash their hands in the correct way, only a few washed their hands for the recommended minimum duration of 20 seconds (9,13).

This study found that participants who sometimes washed their hands before contact with patients, patient beddings, or materials in the patient environment were statistically significant (AOR 1.82, 95% CI 1.04-3.20) compared to those that always washed their hands. This was possible due to a lack of knowledge, a lack of necessary hand washing items, or that some healthcare workers feel overburdened by constantly washing their hands per time or the absence of guidelines or Standard operating procedures (SOP's). This is consistent with previous studies that found low compliance with hand hygiene practices before touching a patient (12,14).

Participants who sometimes washed their hands after contact with patients, patient beddings or materials, or after taking blood samples were statistically significant (AOR 4.51, 95% CI 1.76-11.54) when compared to those who always washed their hands after contact. This was possible due to a lack of hand washing supplies, knowledge gap, or

Table IV. Factors responsible for non-adherence to standard precautions/infection control protocols and use of PPE(s).

Characteristics	Total		Male		Female		Crude Odds Ratio	95% CI*	Adjusted Odds ratio**	95% CI
	n	%	n	%	n	%				
	316	100	118	37.30	198	62.70				
Have you been trained on infection prevention and control protocols?										
Yes	235	74.40	74	31.50	161	68.50	Ref	Ref	Ref	Ref
No	81	25.60	44	54.30	37	45.70	2.58	1.54-4.34	2.33	1.29-4.22
Are infection control policies, guidelines and procedures available?										
Yes	233	73.70	83	35.60	150	64.40	Ref	Ref	Ref	Ref
No	83	26.30	35	42.20	48	57.80	1.32	0.79-2.20	0.81	0.43-1.51
Are you aware of standard Precautions?										
Yes	306	96.80	112	36.60	194	63.40	Ref	Ref	Ref	Ref
No	10	3.20	6	60.00	6	60.00	1.73	0.54-5.50	2.99	0.70-12.79
In emergencies, do you have time to maintain standard precautions?										
Yes	190	60.10	73	38.40	117	61.60	Ref	Ref	Ref	Ref
No	126	39.90	45	35.70	81	64.30	0.89	0.56-1.42	0.63	0.36-1.10
Workload may make it difficult for you to maintain standard Precautions										
Yes	195	61.70	79	40.50	116	59.50	1.43	0.89-2.31	1.22	0.67-2.34
No	121	38.30	39	32.20	82	67.80	Ref	Ref	Ref	Ref
Are PPE's always available?										
Yes	119	37.70	31	26.10	88	73.90	Ref	Ref	Ref	Ref
No	197	62.30	87	44.20	110	55.80	2.25	1.36-3.69	2.39	1.31-4.37
If PPE's are always available, who provides?										
Self	12	3.80	4	33.30	8	66.70	1.48	0.41-5.31	2.06	0.54-7.89
Admin	107	33.90	27	25.20	80	74.80	Ref	Ref	Ref	Ref
Not always available	197	62.30	87	44.20	110	55.80	2.34	1.39-3.94	Undefined	Undefined
Do you feel uncomfortable while using PPE's to perform tasks?										
Yes	128	40.50	48	37.50	80	62.50	1.01	0.64-1.61	0.83	0.47-1.45
No	188	59.50	70	37.20	118	62.80	Ref	Ref	Ref	Ref
Those factors which are psychological such as your appearance affects your use of PPE's										
Yes	105	33.20	43	41.00	62	59.00	1.26	0.78-2.03	1.29	0.70-2.39
No	211	66.80	75	35.50	136	64.50	Ref	Ref	Ref	Ref
Discomfort of patients is a barrier to the use of Personal Protective equipment										
Yes	96	30.40	40	41.70	56	58.30	1.3	0.80-2.12	1.23	0.63-2.40
No	220	69.60	78	35.50	142	64.50	Ref	Ref	Ref	Ref
I am confident and very experienced and may not need to use PPE's										
Yes	38	12	14	36.80	24	63.20	0.98	0.48-1.97	1.19	0.46-3.10
No	278	88	104	37.40	174	62.60	Ref	Ref	Ref	Ref
Are there other reasons for not wanting to use PPE's?										
Yes	48	15.20	22	45.80	26	54.20	1.52	0.82-2.82	1.95	0.82-4.54
No	268	84.80	96	35.80	172	64.20	Ref	Ref	Ref	Ref
The Doctor and head of the team does not maintain Universal precautions										
Yes	93	29.40	30	32.30	63	67.70	0.73	0.44-1.22	0.44	0.23-0.85
No	223	70.60	88	39.50	135	60.50	Ref	Ref	Ref	Ref

forgetfulness among healthcare workers. This is consistent with studies that have found low compliance with proper hand hygiene practices due to infrastructural challenges with the availability of utilities required to perform proper hand hygiene (15). Another study found that a lack of soap and water was a major barrier to handwashing among health workers (9).

Participants who sometimes washed their hands after removing gloves were statistically significant (AOR 1.92, 95% CI 1.08-3.42) compared to those that always washed their

hands. These findings are possible because some healthcare workers believe that gloves serve as a barrier that protects them and the patient from contamination and thus do not feel the need to wash their hands after wearing them. Knowledge gaps, as well as infrastructure challenges such as lack of water all contribute to poor hand washing after removing gloves. This was consistent with a study that found low compliance with hand hygiene practices as well as proper adherence to the various moments of hand hygiene (15). The findings agree with those of another study, which identified inadequate hand hygiene facilities, infrastructural deficiencies, and workload as major barriers to proper hand hygiene practices as well as the perception that hand hygiene is unnecessary after glove removal (16).

Although needle recapping was not statistically significant, many participants 127 (40.2%) always recapped needles after use. This was possible due to a knowledge gap, and lack of training on infection prevention and control, unavailability or use of sharps containers. This was in contrast to the findings from other studies, which found a lower number of healthcare workers practicing needle recapping (10).

Participants who have not been trained in infection prevention and control were statistically significant (AOR 2.33, 95% CI 1.29-4.22) when compared to those that had been trained. This was possible because some healthcare workers may not have received formal organized infection prevention and control training, while others may not have received any training during their undergraduate years. The findings were also consistent with another study in which slightly more than half of doctors received formal training on infection prevention and control (12). This was consistent with other studies that have identified inadequate hand hygiene training as a barrier to proper hand hygiene practices (16).

During the COVID-19 outbreak, the lack of PPE (s) was associated with outright shortages and increased demand. When compared to those who responded that PPE(s) were always available the findings were statistically significant (AOR 2.39, 95% CI 1.31-4.37). This implies that the likelihood of not using PPE(s) was higher than when PPE(s) were always available. This was supported by a study that found a scarcity of and access to essential PPE(s) (17). This was also consistent with another study that found a lack of PPE(s) to be a major challenge for both healthcare workers and managers (18).

Participants who believed the doctor and team leader did not follow universal precautions were statistically significant (AOR 0.44, 95% CI 0.23-0.85). This was possible due to a high workload, a lack of PPE(s) and items for hand hygiene, and a failure to remember the importance of following universal precautions per patient per time. This was supported by an Irish study that discovered suboptimal hand hygiene compliance among doctors before and after contact with patients (19). In a related study, Doctor's adherence to universal precautions such as hand hygiene was generally lower than that of nurses (4).

Strengths and limitations of the study. The study was a cross-sectional study, which was relatively inexpensive and simple to carry out because there was no need to follow up with participants over time. The facility provided easy access to conduct the study because the ethics committee granted ethical approval quickly. The sample size was calculated scientifically using EPI Info Version 7 making it possible and simple to obtain significant findings from the data analysis process. Data was collected using self-administered questionnaires. It allowed for the collection of a large amount of information from participants, saving time and making administration easier for data enumerators. Data analysis was simple using statistical software (EPI Info & SPSS). The findings from the study can also be used to provide feedback and recommendations to the hospital's management and infection control committee.

The use of self-reported data was likely to cause response bias. Limitations from the study arose from observations that would have been a more useful approach to determining infection control practices among healthcare workers. Limitations arose as a result of the COVID-19 pandemic as well as financial and time constraints.

In most cases, healthcare-associated infections endanger the health and well-being of healthcare workers, patients, and the general population. The study explored infection prevention knowledge and practices among healthcare workers, which will help in the development of preventive programs aimed at reducing the impact of hospital-acquired infections.

The study was expected to shed more light on the reasons why healthcare workers struggle to maintain standard infection prevention and control practices such as the use of PPE(s). The study findings may be useful in making recommendations to close the identified gaps and offer solutions to barriers in maintaining standard infection prevention and control practices as well as to increase healthcare workers' knowledge of these practices.

Conclusions

The study findings showed that healthcare workers learned about infection prevention and control from a variety of sources other than television/radio, the internet, and journals. Participants had a low level of knowledge about the actual recommended minimum duration for hand washing. Participants also had a poor practice of hand washing before and after contact with the patient, beddings, materials, and the patient environment or after a procedure. Furthermore, participants practiced poor hand hygiene after removing gloves.

The findings revealed the factors that may be responsible for non-adherence to infection control practices, as well as the use of PPE(s), was the training gap in infection prevention and control among healthcare workers. Nonetheless, PPE(s) were not always available. Furthermore, it can be concluded that the doctor or team leader does not always follow infection prevention and control protocols.

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Availability of data and material

Data and materials are available by the authors.

Contributions

AOO, RHVW, conceptualization, writing, methodology, original draft preparation, review editing; RHVW, supervision. All the authors approved the final version to be published.

Ethical approval and consent to participate

Approval for the study was obtained from the of the University of Johannesburg, Health Science Faculty of Higher Degrees Committee (FHDC) referenced MPH HDC 01-04-2021 and ethical clearance was granted by the Research Ethics Committee (REC) referenced REC 952-2021 as well as the Ethics committee of Federal Medical Center Makurdi FMH/FMC/HRE/01.

Informed consent

Informed consent was obtained from participants while maintaining ethical standards, and anonymity. Participants who agreed to participate signed a consent form voluntarily.

Conflict of interest

The authors declare no potential conflict of interest.

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