Assessing Medical Doctors' Knowledge and their Confidence in Spot Diagnosing Monkeypox in South-South Nigeria

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Abstract:
Human monkeypox is an emerging viral zoonotic infectious disease caused by a DNA virus that belongs to the *Orthopoxvirus* genus. Knowledge of monkeypox, high index and sound clinical judgement particularly amongst medical doctors is critical to responding to monkeypox effectively. Previous studies have shown poor knowledge of monkeypox infection amongst doctors. This study aims to assess doctors' knowledge of monkeypox and their confidence in diagnosing monkeypox prior to laboratory confirmation. A cross-sectional online survey containing 28-item scale and explanatory variables were used to assess respondents' knowledge, confidence and risk perception on monkeypox. The participants were reached with online Google form posted on the Nigerian Medical Association group WhatsApp, Cross River State. The questionnaires were structured closed-ended and were self-administered to collect quantitative data. A total of 164 medical doctors working in Cross River State participated. Only 38 (23.2%) of them had good knowledge of monkeypox, using a > 60% cutoff point for good knowledge. Seventy-two percent (72%) displayed confidence to clinically diagnose monkeypox in their daily clinic runs. There was statistically significant relationship between knowledge category and medical sub-specialties (X^2 =6.98; p=0.03). We conclude that knowledge of monkeypox amongst medical doctors practicing in Cross River State, Nigeria is currently low, though confidence to diagnose it is high, this confidence should be backed with sound medical knowledge to improve doctors' capacity to respond to the emerging monkeypox infection.

Keywords: monkeypox, monkeypox virus, zoonoses, emerging viral infection.

1. Introduction

Human monkeypox (HMPX) is an emerging viral zoonotic infectious disease caused by the monkeypox virus. The virus is an enveloped, double-stranded DNA virus that belongs to the *Orthopoxvirus* genus of the *Poxviridae* family. Other members of this genus are variola virus (agent of smallpox) cowpox virus and vaccinia virus [1] [2]. The similarities in clinical features and cross-protection following smallpox vaccination is conferred by the shared structural characteristics of the viruses causing the two disease entities [3].

First ever reported HMPX case occurred in DR Congo in 1970 in a 9-month year old boy [4]. Two distinct clades of HMPX have been identified: the west African and the Congo Basin clades were responsible for the West and Central African outbreaks respectively [1] [5]. The Congo Basin clade (Central African clade) is associated with more severe disease, higher case fatality and ease of human-to-human transmission, although the two 1971 Nigerian cases of HMPX in a 4-year old child and the mother were caused by West African clade [6]. In 2018-2019, Nigerian travelers were reported to have imported HMPX into Israel, United Kingdom, and Singapore [7], [8], [9]. Another traveler returning from Lagos, Nigeria in July 2021 imported HMPX into Dallas, TX (USA) [10]. HMPX affects people of all age groups, children under the age of 16 are affected most, though this was not the observation in the 2017-2018 Nigerian outbreak [11] [12]. HMPX is transmitted either by direct contact (with skin or mucous membrane lesions or contact with respiratory tract fluids and saliva), or indirectly through contaminated fomites [13], [14]. Some peculiarities of the ongoing outbreak include the observation of transmission clusters among men that have sex with men (MSM, including gays and bisexual men) [13]. The hypothesis of skin-to-skin transmission of HMPX during sex as the dominant mode of transmission among MSM has been put up in Spain in this ongoing outbreak [13]. The current 2022 global epidemiological data shows an overwhelming predominance of males 96.9% (44050/45460) with the median age of 34 years (IQR: 29 - 41). Males between 18-44 years old are disproportionately affected by the

current outbreak as they account for 79.7% of cases. Of all cases reported, only 3.1% (1410/45460) are female. The most commonly reported mode of transmission was a sexual encounter with 13,306 of 18,658 (71.3%) of all reported modes of transmission. For cases where settings were reported, the most common reported setting was in a party setting with sexual contacts with 3,530 of 8,132 (43.4%) [15].

An incubation period of 5 -21 usually elapses before the onset of a prodrome of flu-like symptoms that culminates in skin manifestations evolving from macules to papules, vesicles, and pustules to scabs formation [14] [16]. The rash usually spread centrifugally with lesions showing umbilication. Apart from any rash, other commonly reported symptoms include systemic rash (59.4%), fever (58.1%), genital rash (46%), headache (31.5%), any lymphadenopathy (29.7%), fatigue (29.2%), and muscle ache (28%) [15]. Some unusual manifestations that require hospital admission which include penile swelling and rectal pain have been reported in the current 2022 outbreak [17]. Reports of HMPX complications involving dehydration, respiratory distress, super-infection by bacteria and other features indicate the need for hospital admission in most cases [13]. Previously, the case-fatality rate has been reported at 0-11%, notwithstanding, HMPX-related mortalities for the ongoing outbreak have been very low [18]; the total deaths recorded starting from January 1 to November 7, 2022 is 41 [15]. Improved knowledge of the clinical features of HMPX on the part of HCWs demonstrates their readiness to contain the spread of HMPX, however, vaccination remains the central preventive measure [19] [20]. Smallpox vaccine has been known to provide at least 85% protection against HMPX, hence, the most-at-risk groups should be considered for vaccination [3]. Two smallpox vaccines – ACAM2000 and Jynneos vaccines, both made from vaccinia virus, are already in use in some countries for the prevention of HMPX.

Previous studies have reported healthcare-related transmission in some countries including Nigeria, Republic of the Congo, Central African Republic and DR Congo [12], [21], [22], and [23]. Approximately 1% Healthcare workers (HCWs) have been infected for every 100 HMPX cases [23]. Some studies have shown that knowledge of HMPX among doctors is very low with only small proportion of them having good knowledge [20] [24] [25] [26]. Nigeria being a country endemic with HMPX, should set up HMPX surveillance. To have an effective surveillance system, the capacity of the frontline healthcare workers of HMPX disease should be enhanced to clinically identify cases and manage the disease appropriately. With poor knowledge and not-too-frequent HMPX cases, doctors will not have confidence managing the cases should a more serious HMPX outbreak occur. Therefore, HCWs, particularly, doctors should be considered for focused knowledge and awareness in outbreaks and emergence of novel infectious diseases to have confidence to provide proper responses [27]. The current study was undertaken to assess medical doctors' knowledge and confidence in Cross River State, one of the states in the south-south geopolitical region in Nigeria, in identifying cases of HMPX.

.2. Materials and Methods

2.1 Study Area

The study was carried out in Cross River State, Nigeria. Cross River State is one of the six States situated within the south-south geopolitical zone of Nigeria. The capital city is Calabar. The major towns in Cross River State hosting medical doctors and other medical professionals include Calabar, Akamkpa, Ogoja, Odukpani, Obubra, Ugep, Ikon, Obudu, Akpabuyo, and Obanliku. The State spans over 23, 074 square kilometers and shares boundaries with Benue State to the north, Enugu and Abia States to the west, Republic of Cameroon to the east, and to the south, Akwa-Ibom and Atlantic Ocean [28]. Cross River belongs to tropical rainfall belt. The State experiences an annual rainfall of about 1300 - 3000mm, and 30°C mean annual temperature [28].

2.2 Methods

2.2.1 Study design

A cross-sectional online survey was conducted from 22nd August 2022 to 23rd September 2022 to assess knowledge of human monkeypox (HMPX) and the confidence of medical doctors working in Cross River State, Nigeria.

2.2.2 Study population

The participants comprised of specialists and non-specialist doctors. Core specialists were grouped into surgeons (from General surgery, Intensive care unit, Orthopedic, urology, ear-nose-throat, and Obstetrics and Gynaecology), Physicians (from internal medicine, Paediatrics, community medicine, laboratory medicine, and dermatology), and General practitioners (specialists trained in family medicine plus non-specialists). All the doctors are registered with, and licensed by the Medical and Dental Council of Nigeria (MDCN). These doctors belong to Nigeria Medical Association (NMA), however, in this study, we targeted the members of NMA working either as a private practitioner or employed in the public health (primary, secondary or tertiary health) settings.

During the study, a random selection procedure was used in selecting correctional facilities within the state. The selection was first stratified by size of correctional facility and thereafter three (3) out of seven (7) available correctional facilities were deliberately selected. The selection was done in a way that each of the senatorial districts of the state was adequately represented. More so, the choice of the chosen correctional facilities was informed by the size of the inmates. Hence, correctional facilities that best satisfied the conditions were chosen. The three

2.2.3 Sample size

The sample size was calculated with an online calculator [29] using a confidence level of 95%, margin of error 5%, population size of 450 (number of doctors in Cross River State), and population proportion of 10% based on a similar study [24], a sample size of at least 106 was required for the study, however we used 164. Approximately 6-10 minutes were required to complete the questionnaire.

2.3 Survey Tool

The questionnaire was designed using Google forms (Google LLC; Menlo Park, CA, USA), and was adapted from previously published study of Ricco and colleagues [20]. It consisted of questions to assess the medical doctors' knowledge on HMPX as well as their confidence on spot diagnosing/identifying cases of HMPX.

Reliability of the study questions constructs.

Reliability is the measure of internal consistency of the constructs in the study. A construct is reliable if the Alpha (α) value is greater than 0.7 [30]. Construct reliability was assessed using Cronbach's Alpha. The results revealed that the Monkeypox knowledge questions with 25 items have an Alpha (α) value of 0.741.

The questionnaire was segmented into:

Introductory and e-consent: this had information about the study and its objectives followed by the e-consent for participation.

Biodata: this had information about the socio-demographic characteristics of the participants including age, sex, and marital status.

Medical sub-specialties: the different medical sub-specialties, about twelve of them were included However, the doctors in the different sub-specialties were later summarized into three main sub-group: Surgeons, Physicians and General practitioners.

Knowledge segment: this has a 25-item HMPX questions that assessed knowledge about the cause, transmission, the epidemiology, clinical features, complications, treatment and prevention of HMPX. Response to each item was either "Yes", "No" or "I don't know". Each correct response was scored +1, while wrong response and a missing/ "I don't know" were scored zero. The potential range any participate could obtain was from (0 – 25). This score was normalized to 100% by multiply each correct answer by 4 to give a range of (0 – 100%).

Confident section: This section had just one question that assessed the confidence of the medical doctors to spot diagnose/identify cases of HMPX, prior to the testing result outcome. Response to this item was a "Yes" Or "No".

2.4 Data Analysis

All statistical analyses were performed using IBM SPSS statistical software for Windows (version 19.0 SPSS Inc. Chicago, IL. USA). Continuous and categorical variables were summarized and initially reported as average ± SD, and percent values respectively. Cumulative score, i.e., Knowledge score (KS) was initially normalized as percentage values, before it was dichotomized into poor vs good knowledge. Three cut-off points- 80%, 70%, and >60% were used. Logistic regression analyses were employed to evaluate the associations between the dependent variables (low/high KS and have/have no confidence) and different study independent variables to calculate their odds ratio, *P*-values, and 95%CI. The internal consistency of the knowledge items in the study was tested via calculation of the Cronbach's alpha – which measures how closely a related set of items are as a group, usually considered as a scale of reliability. A score of ≥0.7 is generally considered acceptable. D'Agostino and Pearson omnibus normality tests were used to assess the normality in distribution of the continuous variables. *P*-value of

<0.10 was a reason to reject the assumption of normal distribution for any continuous variable and as such opted for Spearman's rank correlation coefficient. Univariate analyses were conducted based on the Chi-squared (X^2) test. The statistical significance was considered for $p<0.05$.

3.0 Results and Discussion

3.1 Results

3.1.1 Description of the Study Sample

Out of about 450 medical doctors targeted in the WhatsApp platform in which our questionnaire was posted, 164 (36.4%) responded and submitted the survey. Figure 1 shows participants' first source of information on HMPX. Online news media was the most frequent means by which the participants got their first information about HMPX. According to Table 1, vast majority of the doctors are below 43 years (77.4%, n=127), their mean age was 38 ±6.28 years, 97 (59.1%) were male, 122 (74.4%) were married. Concerning the areas of specialization of the

participants, majority of them 70 (47.3%) were physicians. Tables 2-5 show different aspects of the features of human monkeypox disease.

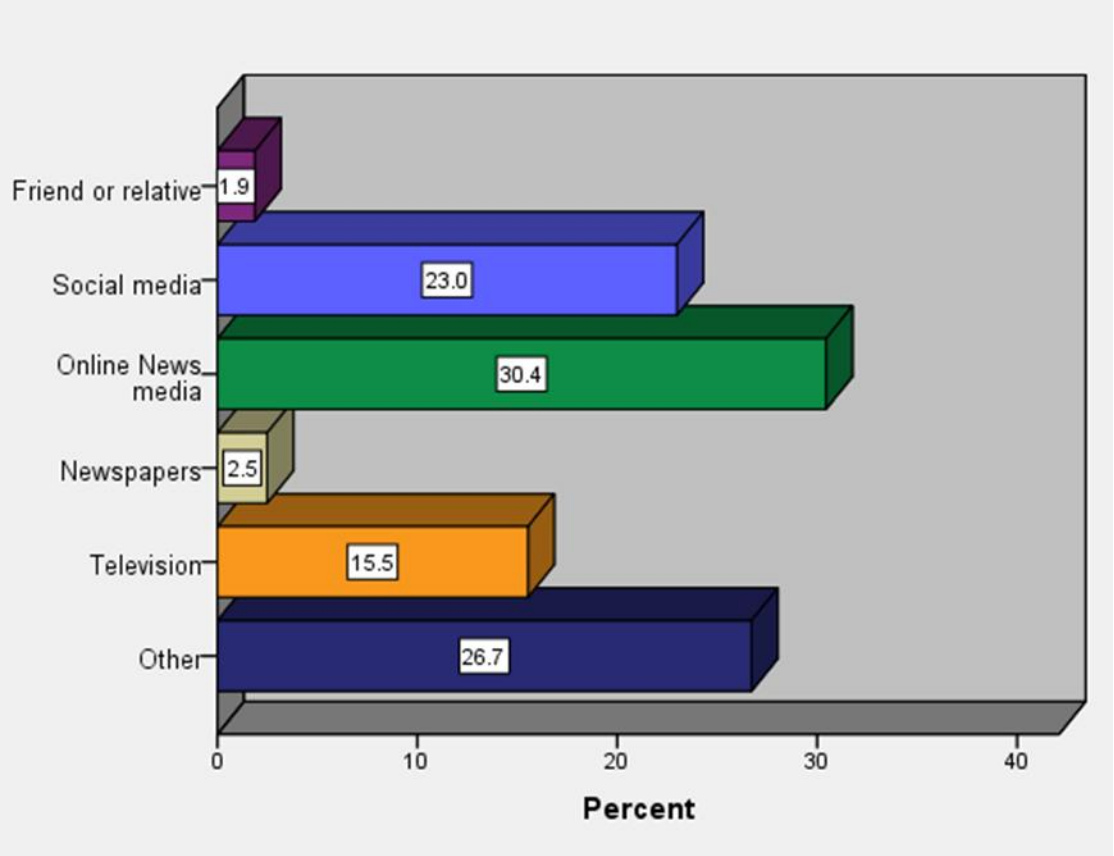

Figure 1. First source of information on HMPX for the participants

Table 1. Characteristics of the Medical doctors that participated in the survey on knowledge.

Variables	n (%)
Mean age ± SD (in years)	38.28±6.28
Age groups	
< 43 years	127(77.4)
43 years and above	37(22.6)
Gender	
Female	67(40.9)
Male	97(59.1)
Marital status	
Single	42(25.6)
Married	122(74.4)
Medical sub-specialty	
Physicians	70(47.3)
General Practitioners	42(28.4)
Surgeons	36(24.3)

n = a sub-set of the total participants that was sampled against the variable. % = the corresponding percentage.

Table 2. Human monkeypox Epidemiology and Features

Variable	n (%)
MPX is caused by a newly discovered virus.	
False	130(79.3)
True	27(16.5)
Don't know	7(4.3)
MPX virus circulates only among primates, including humans.	
False	
True	55(34.0)
Don't know	100(61.7)
	7(4.3)
In most cases, MPX evolves in an uncomplicated influenza-like illness.	
False	26(15.9)
True	123(75.0)
Don't know	15(9.1)
MPX infections are associated with typical skin lesions	
False	
True	4(2.4)
Don't know	159(97.0)
	1(0.6)
Asymptomatic individuals are critical in circulating MPX	
False	
True	24(14.7)
Don't know	121(74.2)
	18(11.0)
Until recently, Nigerian cases of MPX have been mostly travel-associated	
False	41(25.0)
True	101(61.6)
Don't know	22(13.4)

n = a sub-set of the total participants that was sampled against the variable. % = the corresponding percentage.

Table 3. Human monkeypox Drugs and Vaccine

Variable	n (%)
Is there any effective vaccine against MPX available as yet?	
No	
Yes	83(50.6)
Don't know	40(24.4)
	41(25.0)
Are there any effective drugs targeting MPX virus as yet available?	
No	89(54.3)
Yes	36(22.0)
Don't know	39(23.8)
Recipients of Smallpox vaccine do not need further Monkeypox vaccine	
False	69(42.1)
True	32(19.5)
Don't know	63(38.4)

n = a sub-set of the total participants that was sampled against the variable. % = the corresponding percentage.

Table 4. Human monkeypox Transmission routes

Variable	n (%)
MPX may be transmitted through the respiratory system.	
False	
True	22(13.4)
Don't know	129(78.7)
	13(7.9)
MPX may be transmitted through the respiratory droplets.	
False	
True	15(9.1)
Don't know	137(83.5)
	12(7.3)
MPX may be transmitted through body fluids.	
False	9(5.5)
True	145(88.4)
Don't know	10(6.1)
MPX may be transmitted through body contacts.	
False	7(4.3)
True	144(87.8)
Don't know	13(7.9)

n = a sub-set of the total participants that was sampled against the variable. % = the corresponding percentage.

Table 5. Clinical features and Complications of HMPX

Variable	n (%)
MPX infection is associated with a high rate of systemic complications.	
False	27(16.5)
True	54(32.9)
Don't know	49(29.9)
MPX causes a less severe illness in children (age < 14-year-old) than in adults.	
False	54(32.9)
True	49(29.9)
Don't know	61(37.2)
MPX infection is usually associated with a … lymphadenopathy.	
Not noticeable	
Typical, cervical and/or inguinal	11(6.7)
Typical, in axillary and/or groin nodes	90(54.9)
Don't know	18(11.0)
	45(27.4)
The skin rash associated with MPX is typically asynchronous.	
False	
True	47(29.0)
Don't know	72(44.4)
	43(26.5)
Surface extension and profusion of MPX-associated skin lesions are of prognostic value.	
False	15(9.1)
True	100(61.0)
Don't know	49(29.9)
MPX-associated skin lesions may be differentially diagnosed according to their stage:	
Varicella / Varicella-Zoster	46(28.6)
Typhus	0(0.0)
Molluscum contagiosum / water warts	13(8.1)

Syphilis	1(0.6)
Herpes simplex	1(0.6)
All of the above	100(62.1)
Standard preventive measures are effective in preventing MPX infection	
False	3(1.8)
True	154(93.9)
Don't know	7(4.3)
A clinical case characterized by: (1) atypical skin rash; (2) lymphadenopathy (cervical and/or inguinal); (3) history of travel to countries endemic for MPX	
Don't know	
Confirmed Monkeypox case	18(11.0)
Probable Monkeypox case	33(20.1)
Doubtful Monkeypox case	112(68.3)
	1(0.6)
A clinical case characterized by: (1) generalized or localized skin rash, either maculopapular or vesiculopustular; (2) umbilicated skin lesions; (3) lymphadenopathy	
Don't know	
Confirmed Monkeypox case	23(14.1)
Probable Monkeypox case	31(19.0)
Doubtful Monkeypox case	87(53.4)
	22(13.5)
The case-fatality ratio of smallpox usually ranged between	
4% and 11%	
14% and 19%	42(25.8)
20% and 30%	9(5.5)
30% and 40%	20(12.3)
Don't know	19(11.7)
	73(44.8)
The case-fatality ratio ranges of Monkeypox	
4% and 11%	75(46.0)
14% and 19%	7(4.3)
20% and 30%	5(3.1)
30% and 40%	5(3.1)
Don't know	71(43.6)
MPX is able to survive for several days on contaminated surfaces	
False	27(16.6)
True	80(49.4)
Don't know	55(34.0)

n = a sub-set of the total participants that was sampled against the variable. % = the corresponding percentage.

3.1.2 Knowledge Test

Table 6 shows response distribution to the "Knowledge test" items made by the medical doctors that participated in the survey.

In this study, three cut-offs - > 60%, 70%, and 80% were used as good knowledge, however, only >60% cut-off was used for further exploratory analyses other than descriptive statistics. Mean knowledge score (SD) was 52 ± 13.36, highest score was 80 while lowest was 8. Proportion of participants with good knowledge were 1.2% (n=2), 7.9% (n=13), and 23.2% (n=38) based on the 80%, 70%, and > 60% cut-offs respectively. The physicians showed higher level of knowledge of HMPX (25.7%, $p>0.05$) compared to other Doctors in other sub-specialties (Figure 2). Looking at the response distribution of the "Knowledge test" in Table 6 briefly: Majority of the participants (79.3%, n=130) recognized the fact that monkeypox virus has been in existence and not a

newly discovered virus. Interestingly, almost all the participants acknowledged that HMPX infections are associated with typical skin lesions (97.0%, n=159), however, only 55 (34.0%) acknowledged that monkeypox viruses do also circulate in other animals other than primates, and only 24 (14.7%) had knowledge that asymptomatic individuals are not critical in circulating HMPX. On answering questions on the modes of transmission of HMPX, majority of them got it correctly that HMPX can be transmitted via respirator system (78.7%), respiratory droplets (83.5%), body fluids (88.4%), and body contacts (87.8%), however, they performed poorly in refuting the statement that "until recently, Nigerian HMPX cases have been mostly travel-associated" (25.0%). They also performed poorly in acknowledging that there are currently effective drugs (22.0%, n=36) and vaccines (24.4%, n=40) for treatment and prevention of HMPX.

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Table 6. Response distribution of the "Knowledge test" items made by the medical doctors that participated in the survey.

Statement	Correct Answer	N (%)
MPX is caused by a newly discovered virus.	False	130(79.3)
MPX virus circulates only among primates, including humans.	False	55(34.0)
In most cases, MPX evolves in an uncomplicated influenza-like illness.	False	26(15.9)
MPX infections are associated with typical skin lesions	True	159(97.0)
Asymptomatic individuals are critical in circulating MPX	False	24(14.7)
Until recently, Nigerian cases of MPX have been mostly travel-associated.	False	41(25.0)
Is there any effective vaccine against MPX available as yet?	Yes	40(24.4)
Are there any effective drugs targeting MPX virus as yet available?	Yes	36(22.0)
Recipients of Smallpox vaccine do not need further Monkeypox vaccine	False	69(42.1)
MPX may be transmitted through the respiratory system.	True	129(78.7)
MPX may be transmitted through the respiratory droplets.	True	137(83.5)
MPX may be transmitted through body fluids.	True	145(88.4)
MPX may be transmitted through body contacts.	True	144(87.8)
MPX infection is associated with a high rate of systemic complications.	True	54(32.9)
MPX causes a less severe illness in children (age < 14-year-old) than in adults.	False	54(32.9)
MPX infection is usually associated with a … lymphadenopathy. Typical, cervical and/or inguinal	Typical, cervical and/or inguinal	90(54.9)
The skin rash associated with MPX is typically asynchronous.	False	47(29.0)
Surface extension and profusion of MPX-associated skin lesions are of prognostic value.	True	100(61.0)

MPX-associated skin lesions may be differentially diagnosed according to their stage:		
Varicella / Varicella-Zoster	False	46(28.6)
Typhus	False	0(0.0)
Molluscum contagiosum / water warts	False	13(8.1)
Syphilis	False	1(0.6)
Herpes simplex	False	1(0.6)
All of the above	True	100(62.1)
Standard preventive measures are effective in preventing MPX infection.	True	154(93.9)
A clinical case characterized by: (1) atypical skin rash; (2) lymphadenopathy (cervical and/or inguinal); (3) history of travel to countries endemic for MPX.	Probable Monkeypox case	112(68.3)
A clinical case characterized by: (1) generalized or localized skin rash, either maculopapular or vesiculopustular; (2) umbilicated skin lesions; (3) lymphadenopathy	Probable Monkeypox case	87(53.4)
The case-fatality ratio of smallpox usually ranged between	30% and 40%	19(11.7)
The case-fatality ratio ranges of Monkeypox	4% and 11%	75(46.0)
MPX is able to survive for several days on contaminated surfaces	True	80(49.4)

N =the number of participants that responded correctly to the variable. % = percentage of the participants that responded correctly to the variable. MPX = monkeypox.

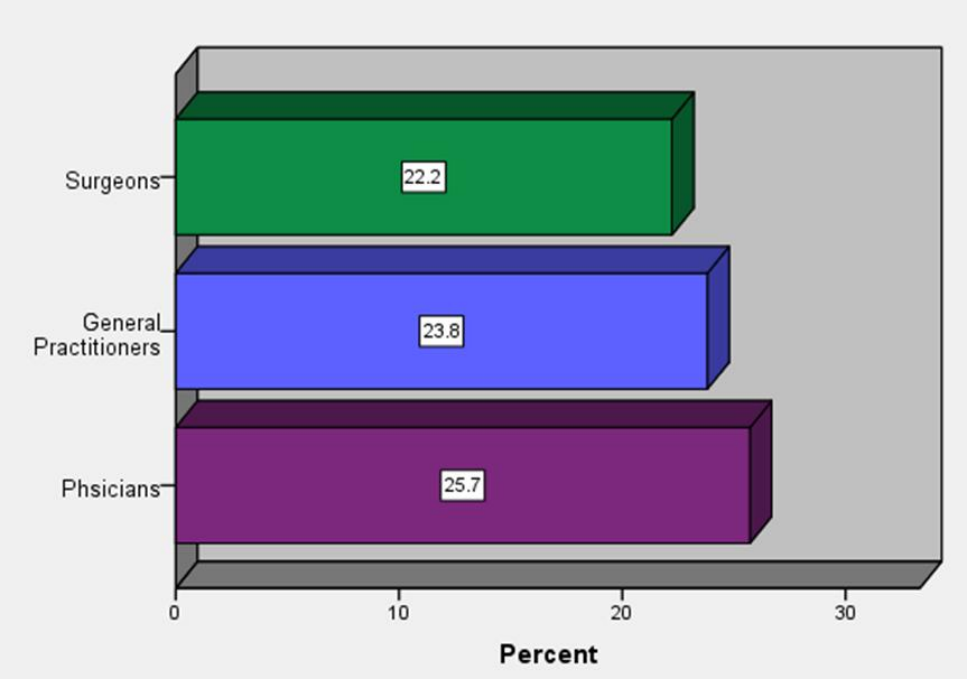

Figure 2. Percentage of doctors among sub-specialties with good knowledge score

3.1.3 Univariate and multivariate analyses

Chi-squared test was initially used to test for relationship between knowledge category (good and poor knowledge) and a number of independent variables, however, there was no relationship between the knowledge group and any of the variables (Table 7). Furthermore, the same independent variables were applied as predictors in a multivariate logistic regression analysis to assess their predictability on the knowledge category but were also found to be non-statistically significant (Table 7).

However, using a nonparametric correlation (Spearman's rank), confidence level of doctors in spot diagnosing HMPX there was a positive relationship with knowledge score that was moderate in strength and statistically significant (rho: 0.243; p=000). The knowledge score was computed by summing up the correct responses per participant. Correct response got 1, while wrong response was scored zero.

Table 7. Univariate analysis of knowledge level and logistic regression analysis showing predictors of level of knowledge about the Monkeypox among medical doctors.

Variable	N (%)	Poor Knowl-edge n (%)	Good knowledge n (%)	X^2	*P*-value	Logistic Regression		
						B	OR (95%CI)	*P*-value
Age group	164							
< 43 years	(100)	97 (76.4)	30 (23.6)	0.06	0.800	0.21	1.23 (0.48-3.12)	0.666
43 + years*		29 (78.4)	8 (21.6)					
Gender	164							
Female	(100)	53 (79.1)	14 (20.9)	0.329	0.566	-.07	0.93(0.42-2.05)	0.862
Male *		73 (75.3)	24 (24.7)					
Marital	164							
Single	(100)	32 (76.2)	10 (23.8)	0.01	0.909	0.00	1.0(0.40-2.45)	1.00
Married*		94 (77.0)	28 (23.0)					
Sub-specialty	148							
Physicians	(90.2)			0.17	0.92			
General		52 (74.3)	18 (25.7)			0.05	1.05(0.395-2.78)	0.93
Practitioner		32 (76.2)	10 (23.8)			0.06	1.06(0.30-3.09)	0.92
Surgeons*								
		28 (77.8)	8 (22.2)					
Confidence Level	161 (98.2)							
Somewhat not		38 (84.4)	7 (15.6)	2.24	0.134	-.59	0.56 (0.21-1.44)	0.22
Somewhat* confident		85 (73.3)	31 (26.7)					

* = reference variable for logistic regression analysis. N =total number of variable's respondents. n = sub-set of N. % = percentage of respondents

3.1.4. Confidence Test

Figure 3. shows that 72% of the participants were somewhat confident to be able spot diagnose or identify cases of HMPX based on clinical features prior to confirmation via testing. Considering the Univariate Analysis, there was significant statistical association between knowledge category and medical sub-specialties (X^2 =6.98; p=0.03). More than three-quarter of the participants with good knowledge also showed confidence to spot diagnose HMPX (81.6%, n=31, X^2: 2.24, p>0.05), though this was not statistically significant Table 8.

Logistic regression analysis was employed to predict the probability that a participant would have confidence to spot diagnose cases of HMPX. The predictor variables participants' age group, gender, marital status, medical sub-specialties, and knowledge category. Using surgeons' dummy variable, physicians are 2.7 times odds more confident to spot-diagnose HMPX cases than the surgeons (OR:2.72, 95%CI: 1.04-7.12, p=0.04). Also, using inverted odd ratio, participants aged 43 years and above have 3.0 times odds of having no confidence at spot diagnosing HMPX than younger generation doctors (Table 8). No significant association existed between the predicted variable (confidence group) and

the predictors - sex, marital status, and knowledge category as shown in Table 8.

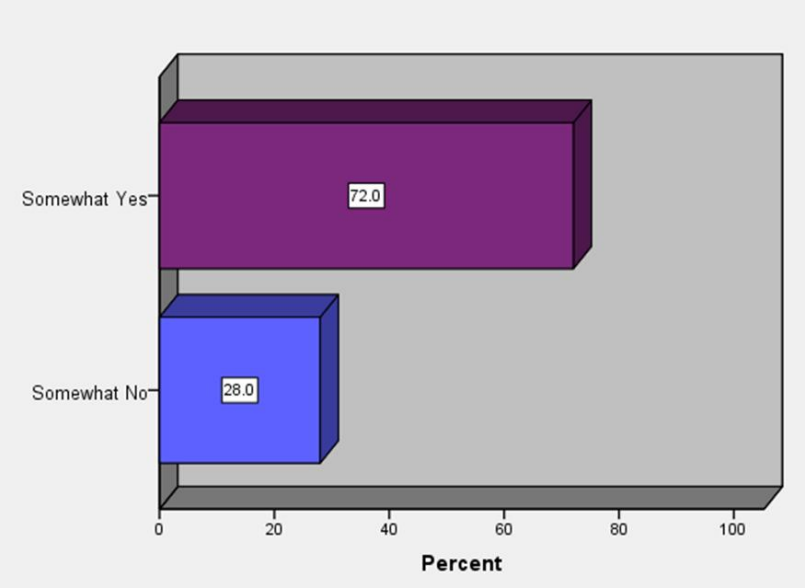

Figure 3. Are you confident to be able to recognize incident Monkeypox cases during your daily activities?

Table 8. Univariate analysis of doctors' confidence to spot diagnose HMPX cases and the logistic regression analysis showing the predictors of their confidence to spot diagnose cases of HMPX.

Variable	**N (%)**	**Somewhat No n (%)**	**Somewhat Yes n (%)**	**X^2**	***P*-value**	**Logistic Regression**		
						B	**OR (95%CI)**	***P*-value**
Age group	161						0.33(0.11-0.97)	
< 43 years	(98.2)	39 (31.5)	85 (68.5)	3.29	0.07	-1.1		0.04
43+ years*		6 (16.2)	31 (83.8)					
Gender	161							
Female	(98.2)	18 (27.3)	48 (72.7)	0.03	0.87	0.06	1.06(0.48-2.34)	0.88
Male *		27 (28.4)	68 (71.6)					
Marital	161							
Single	(98.2)	12 (29.3)	29 (70.7)	0.05	0.83	0.29	1.34(0.54-3.29)	0.53
Married*		33 (27.5)	87 (72.5)					
Sub-specialty	147							
Physicians	(89.6)			6.98	0.03			
General		12 (17.1)	58 (82.9)			0.10	2.72(1.04-7.12)	0.04
Practitioner		16 (38.1)	26 (61.9)			-.12	0.89(0.34-2.34)	0.80
Surgeons*								
		12 (34.3)	23 (65.7)					
Knowledge	161			2.24	0.13			
category	(98.2)							
Poor		38 (30.9)	85 (69.1)			-.59	0.55 (0.21-1.43)	0.22
Good		7 (18.4)	31 (81.6)					

* = reference variable for logistic regression analysis. N =total number of variable's respondents. n = sub-set of N. % = percentage of respondents

3.2 Discussion of Results

The role doctors play in containing infectious diseases globally cannot be overemphasized, especially when the threat level has reached a threshold when it is considered a public health emergency of international concern (PHEIC) as was the case with HMPX [31]. HMPX, as a rapidly spreading re-emerging zoonotic infection with potential for sexually-oriented transmission represent a new challenge to healthcare workers in general and doctors in particular even as the world is grappling with COVID-19 [32]. In public health emergencies, doctors are at the frontline in detecting, diagnosing, treating and following up suspected and confirmed cases. To perform these duties appropriately, effectively and promptly, the medical doctor should have good knowledge and confidence in taking clinical decisions. This study aimed to assess how knowledgeable the medical doctors working in one of the south-south states in Nigeria were about HMPX, and also the proportion of them that can confidently spot diagnose HMPX. Previous and recent studies had also set out to achieve similar objectives as in this current study, much of this study was also designed to accomplish similar aim [20] [24] [25] [26] [33]. In medicine, history taking and clinical examination are key preludes to clinical decision and presumptive diagnosis. In developing countries like Nigeria, where what it takes to make a prompt and confirmatory diagnosis of HMPX may not be available, clinical acumen and high index of suspicion become critical in diagnosis and management of suspected cases of HMPX.

According to the results of our analyses, the mean age of 38 years, and majority of the participants being less than 43 years, this connote that the participants are majorly contemporary, young and energetic practitioners. This also means that most of the participants are post-smallpox eradication practitioners, who probably may not know much about the transmission, features and epidemiology of smallpox. An extremely interesting demographic finding of this study was that the proportion of female-to-male (40.1%/59.1%) participants corresponded exactly to the 2006 National population Commission census result [34] [35]. The sex and age distribution of any population has the fundamental implications of determining society's potentials and manpower supply, and serve as indices for the plan of development of the economy and cultural life of our socialist society [36]. Another interesting demographic feature of the current study is that majority of the respondents are married. The culture of the study population may proffer explanation to this as the culture settings of the study population encourages early marriage.

The findings of this study reveals that the level of knowledge of HMPX among the medical doctors practicing in Cross River State, Nigeria is extremely low. Setting the cut-off for good level of knowledge of HMPX at 80% and 70% as used in previous studies [20] [24], only 1.2% and 7.9% respectively had good level of knowledge. Because of this poor performance, a third cut-off point of > 60% was introduced and this raised the proportion of good knowledge level to 23.2%. This third cut-off of >60% was then used in all the exploratory analyses in the study. Harapan *et al.* using a 80% cut-off, reported a less than 10% proportion of General Practitioners having a good knowledge of HMPX in a study conducted in 2020 [24]. A study in Iraq and Saudi Arabia among the general public also reported low knowledge levels of HMPX [37], [38]. Other previous similar studies had also indicated poor knowledge of HMPX among Physicians in Italy [20], HCWs in Middle East [26] and medical students in Jordan [39], and clinicians in Ohio, USA [40]. The poor attention being given to poxviruses in education and medical training since after smallpox eradication in 1980 could explain the poor knowledge level reported in this study as majority of the participants are younger than 43 years [16] [20] [24] [33]. Another reason put up for the poor knowledge level was the exclusion of, or low coverage of topics on HMPX during medical training and in other health-related events [24]. Perhaps, few areas HCWs knowledge should urgently be upgraded in treatment and prevention of HMPX. Only small proportion of the participants in this study were aware of effective drugs and vaccines for the treatment and prevention of HMPX. As it was in a study conducted by Bates et al. in Ohio USA, doctors in this study were largely unaware that children are even at higher risk of the complications of HMPX than adults, and that systemic involvement is common with HMPX [40]. Bates et al. also emphasized the need to find out the most relevant gaps in knowledge for the specific clade of HMPX outbreak in a given region or nation. For example, while HMPX outbreaks in USA and Europe have been spreading largely as sexually transmitted infections, most African cases were thought to spread via zoonotic mechanisms [12] [38]. Yinka et al. among other factors, considered increased encroachment of wildlife habitats by humans due to hunting and urbanization, flooding occasioned by heavy rainfall that brings humans and monkeypox-infected animal host close together, and high trades on rodents/bushmeats brought by increased demand in consumption of barbequed bushmeats [12]. Majority of the participants in this study wronged alluded the HMPX outbreak in Nigeria to travel-related. Though, majority of the study participants correctly identified different modes by

which HMPX is transmitted to humans including through respiratory droplets, body fluids, and body contacts, it is important that special update courses and training be organized for doctors to bring them to an acceptable level of knowledge for good clinical practice.

The importance of implementing proper infection prevention and control measures without exaggeration can only be appreciated when one understands the mechanisms and dynamics of HMPX transmission [41]. Poor knowledge or inaccurate information about HMPX clinical features could cause a doctor to lose confidence, becomes fidgety and ultimately could lead to a waste of scarce resources by ordering of unnecessary diagnostic tests.

For the item" Asymptomatic individuals are critical in circulating MPX", only 14.7% of the participants got it correct that asymptomatic individuals are not critical in transmission of HMPX. Prior to the 2022 HMPX outbreak, human-to-human transmission of HMPX has been reported and its evidence has been heightened with the current ongoing 2022 outbreak, however, what is known is that transmission requires close contact and this is not as common as it occurs with infections by respiratory viruses like SARS-CoV-2 [41] [42]. Providing accurate information about HMPX among HCWs should be emphasized at all times, because these information trickle down to the general public and patients who will need them to stay safe, alert, and avoid panicking [41].

Generally, the doctors from the three different sub-specialties indicated poor knowledge of HMPX, however, surgeons were the worst, while the physicians were the best of the three sub-specialties. Sallam et al. in their study in a Middle Eastern Country, and Alsanafi et al. in another study in Kuwait had a similar observation of physicians displaying a higher level of knowledge than others from other sub-specialties [26]. The implication of this finding is that efforts should be made to find out why some sub-specialties lag behind in knowledge about a disease entity of public health importance. Also, efforts should be made to educate and train those lagging in knowledge of HPMX in a more tailored approach to address the peculiarities of the sub-specialties.

Our study found that about three-quarter (72%) of the participants displayed confidence to clinically diagnose monkeypox in their daily clinic runs. Accordingly, physicians who disproportionately showed to be more knowledgeable about HMPX than their colleagues in other sub-specialties, also indicated to be more confident to spot diagnose or identify cases of HMPX. This contrasts the finding in a study by Alsanafi et al. where physicians had higher knowledge but less confidence in diagnosing and management of HMPX [25]. However, Sallam et al. study revealed that higher HMPX knowledge was significantly associated with high confidence level in HMPX diagnosis and management [26]. They therefore suggested that improving knowledge of HCWs will serve as a confidence booster in HMPX management which ultimately will result in better response to the ongoing outbreak. Younger medical practitioners were found to be more confident to detect HMPX than their older counterparts. A possible explanation to this could come from the fact that the majority of the study participants are young doctors, and report has shown that younger generation tend to use the internet and social media in Nigeria more, compared to the older generation [43]. The younger is more internet-friendly and therefore much easily and more frequently access online information regarding HMPX via internet, while the older generation may rely more on their experience rather than other sources. The more information the younger generation got from online sources, gave them an edge in knowledge over their older counterparts and this could have contributed also to increasing their confidence.

With the current revolution of the social media and internet, a reliable source of health information is critical to building a strong foundation of health knowledge [44]. This is an interesting area for researchers in Nigeria to work on to find out how Nigerian population seek their health information.

This study therefore sought to know media sources from where the respondents received information about HMPX. Unlike the finding in the survey by Harapan et al. where about three-quarter of the participants received HMPX information from online media, it was observed that the participants sources of information of HMPX was almost uniformly distributed across different media sources, including online news media, newspapers, television, friends/relatives etc. [24].

This study was not bereft of limitations. Because this study was an online survey that was based on access to internet, there was the possibility of biases which could be traced to internet strength and availability in different locations participants reside within the study location [45]. Being an online survey with convenience sampling method, it was prone to selection bias. Being a self-administered kind of survey, some participants could have looked up the correct answers from internet or literatures instead of answering them based on their current knowledge. This study could have suffered from self-selection bias that occurs when study participants exercise the control to participate in a study or not, as such those that would eventually decide to participate may not be representative of the entire population [46].

4. Conclusion

Knowledge of HMPX amongst medical doctors practicing in Cross River State, Nigeria was generally very low while their confidence to spot-diagnose the same disease entity was high. The scenario was that of high confidence without commensurate knowledge. Though not statistically significant, higher level of HMPX knowledge was found amongst physicians compared to doctors from other specialties. Confidence was not significantly associated with knowledge; however, it was associated with medical sub-specialties and age of the participants with physicians being more confident than doctors from other sub-specialties and younger doctors being more confident to spot diagnose HMPX than their older counterparts. Our study findings highlight the urgent need to increase awareness of HMPX amongst these doctors. There is also need to consider introducing HMPX courses and topics into medical students/resident training curricula, including adding it as part of residents' annual revision/update courses. The introduction of these measures will build capacity, confidence and the preparedness of medical doctors in Cross River State to contain HMPX should the outbreak worsens or get to a pandemic level.

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