



OPEN Assessment of knowledge and attitude of healthcare professionals towards Mpox in a Nigerian hospital

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Mpox is a zoonotic viral disease that presents significant public health challenges. Despite the pivotal role of healthcare workers, research on their knowledge and attitudes towards mpox is limited. This study aimed to assess healthcare workers' knowledge, awareness and attitude regarding mpox as well as associated factors at Rivers State University Teaching Hospital in Nigeria. A descriptive cross-sectional study design was employed, utilizing a 34-item semi-structured questionnaire. Knowledge levels were categorized as good (> 70% score), fair (50–69%), or poor (< 50%), while attitudes were classified as positive (> 70% score), moderate (50–69%), or negative (< 50%). Statistical analyses included independent sample T-test, One-way Analysis of Variance, and Chi-square tests. Among a total of 227 healthcare professionals, majority were females (59%) and singles (54.2%). Over 79% correctly identified mpox as a viral infection, while 59.9% recognized its potential transmission through a monkey bite. Overall, 22.5% demonstrated good knowledge. Majority (61.7%) acknowledged the potential of mpox as a worldwide pandemic, with 89% agreeing it could strain affected countries' healthcare systems. Healthcare workers exhibited moderate to positive attitudes towards mpox. Gender (Males, $p = 0.003$), age (> 40 years ($p = 0.008$), years of experience (6–10 years; $p < 0.001$), professional qualification (physicians, $p = 0.002$), and previous mpox training ($p < 0.001$) significantly influenced knowledge levels, but no significant associations were found between demographic variables and attitudes. The study revealed a high level of awareness but low to fair knowledge among most participants. Healthcare professionals also demonstrated moderate to positive attitudes towards mpox. Factors such as gender, age, years of experience, professional qualification, and previous training on mpox influenced knowledge levels, but did not influence attitude in the study participants highlighting the importance of targeted educational interventions.

Keywords Mpox, Knowledge, Awareness, Attitude, Healthcare professionals, Nigeria

Mpox is a rare zoonotic viral disease that belongs to the same family as smallpox, causing a pox-like rash. It primarily spreads from animals, particularly rodents, to humans, with human-to-human transmission occurring through close contact. While mpox has historically been concentrated in Central and West Africa, cases have also been reported in the UK and the United States¹. Since May 2022, a global outbreak has escalated the situation, leading the World Health Organization (WHO) to declare mpox an international public health emergency, urging countries to implement control measures².

The recent resurgence is concerning, particularly with the emergence of a new strain, Clade Ib, which has spread to previously unaffected regions of the Democratic Republic of the Congo and to other countries that had not previously reported mpox cases³.

Transmission occurs through direct contact with infected animals or tissues, as well as via respiratory droplets or contact with infected skin lesions between humans. Symptoms typically include fever, headache, swollen lymph nodes, chills, fatigue, followed by a rash that spreads from the face to the body⁴. The disease can range in severity from mild and self-limiting to severe, with occasional fatalities. While no specific antiviral

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treatment exists, supportive care can alleviate symptoms, and smallpox vaccination offers some cross-protection⁵. Preventative measures include avoiding contact with infected animals and adhering to strict infection control protocols in healthcare settings.

Healthcare workers play a crucial role in managing infectious diseases like mpox, particularly in diagnosing, treating, and preventing its spread⁶. However, many healthcare workers report uncertainty in diagnosing and managing mpox due to its clinical similarity to other conditions such as measles, chickenpox, and sexually transmitted infections⁷. Enhancing their knowledge of mpox, including its risk factors, early symptoms, and protective measures, is critical for early recognition and containment⁷.

Historically, the Democratic Republic of the Congo has reported the majority of human mpox cases, with over 1,000 cases annually in the past three decades. In 2020, the DRC reported 6,257 suspected cases, and in the first four months of 2022, 1,238 new cases were documented⁸. Outside Africa, the first human mpox cases occurred in the United States in 2003, linked to exposure to infected pet prairie dogs that contracted the virus from exotic animals imported from Ghana⁹. Since the first confirmed case in the UK on May 13, 2022, over 100,000 cases have been reported across 122 countries as of October 2024, including 115 countries where mpox had not previously been reported¹⁰. In Nigeria, mpox re-emerged in 2017, with 230 confirmed cases across 20 states and Abuja reported between 2017 and 2022^{11,12}.

The re-emergence of mpox raises concerns about healthcare workers' knowledge and attitudes towards the disease^{13,14}. Inadequate knowledge and negative attitudes among healthcare professionals can hinder effective patient care and public health efforts. Despite the potential impact of mpox outbreaks, limited research exists on healthcare workers' knowledge and attitudes, particularly in developing countries [13, 15]. Understanding these gaps is crucial for improving preparedness and response strategies, as early detection can lead to better patient outcomes and reduced transmission¹⁵.

A global systematic review and meta-analysis involving 27,731 healthcare workers across 22 studies reported that only 26% had good knowledge, while 34.6% had a positive attitude towards mpox¹⁶. Similar findings were noted in Egypt¹⁷ and Nigeria¹⁸, where healthcare professionals demonstrated suboptimal levels of knowledge about mpox.

Healthcare professionals are trusted sources of health information, and their knowledge, attitudes, and behaviors strongly influence community responses to public health threats¹⁹. They often serve as the first point of contact for health information, especially in areas with limited access to reliable communication channels. Effectively conveying accurate and timely information about diseases like mpox is essential for improving public awareness, promoting preventive behaviors, and ensuring adherence to public health measures^{20,21}.

Research shows that when healthcare professionals possess good knowledge and a positive attitude toward an emerging disease, they are more effective in educating and reassuring the public, which helps reduce misinformation and panic. Conversely, gaps in their understanding can undermine public health efforts, as the information they provide directly influences the health behaviors of the communities they serve²². Strengthening the knowledge base of healthcare workers about mpox is not only essential for their clinical practice but also for enhancing public health education and preventive strategies in their communities.

Understanding healthcare workers' attitudes toward mpox can provide valuable insights into their risk perception and willingness to adhere to safety protocols. Given the potential for international transmission, healthcare workers' knowledge and attitudes are vital for global health security, as they contribute to enhancing global surveillance and response mechanisms.

This study was conducted to assess the knowledge, awareness, and attitudes of healthcare workers in Rivers State University Teaching Hospital towards mpox. It also examined the factors associated with healthcare professionals' knowledge and attitudes, with the aim of informing targeted interventions to improve the management of mpox cases, protect the safety of healthcare workers, and strengthen public health efforts.

Methods

Description of study area

The study was conducted in Rivers State University Teaching Hospital. Rivers state is located in the southern part of Nigeria, in the Niger Delta region. It is located in the geographical center of Nigeria and lies between a longitude of 7.0143° E and a latitude of 4.7796°N. It is one of the 36 states in the country and has a population of over 5 million people, making 6th most populous state in Nigeria. The capital of Rivers state is Port-Harcourt, which is also the largest city in the state and serves as the commercial center of the Nigerian oil Industry. The state is bordered by Imo and Anambra to the north, Abia and Akwa Ibom to the east, Bayelsa and Delta to the west²³.

The Rivers State University Teaching Hospital formerly known as Braithwaite Memorial Specialist Hospital was established in March 1925 as a medical facility for senior civil servants. The hospital has various departments, including medicine, Pediatrics, laboratories, Radiology, Family medicine, Surgery, pathology, Accident Centre and the Surgical/Medical emergency etc. The hospital has 375 licensed beds and 731 medical staff members.

Research design

A descriptive cross-sectional study design was employed to assess the knowledge, awareness, and attitudes towards mpox among healthcare professionals at RSUTH. A cross-sectional study observes a defined population at a single point in time, allowing for the analysis of the prevalence of outcomes and exposures simultaneously²⁴. This design is suitable for describing characteristics within a population and for identifying associations between variables without inferring causality. The descriptive nature of the study provides detailed information on the variables of interest, which is essential for understanding the current state of mpox-related knowledge and attitudes among healthcare workers.

Study population and duration

The research population focused on health care workers in Rivers State Teaching Hospital (RSUTH) which include doctors, nurses, pharmacists and medical laboratory scientists. This study was carried out from January to March, 2024.

Inclusion and exclusion criteria

Inclusion criteria

- Healthcare professionals (physicians, nurses, pharmacists, medical laboratory scientists) directly involved in patient care at RSUTH.
- Healthcare workers who have been practicing at RSUTH for at least the past 12 months.
- Individuals who provided informed consent to participate in the study.

Exclusion criteria

- Healthcare professionals who have not been practicing for the past 12 months or were on extended leave during the study period.
- Individuals who declined to participate or were unavailable during data collection.

Operational definitions of key variables

To ensure clarity and consistency in data collection and analysis, the following operational definitions were used:

- **Knowledge of mpox:** Refers to the correct understanding of mpox, including its causative agent, modes of transmission, clinical manifestations, preventive measures, and treatment options. This was assessed with multiple-choice and yes/no questions. A higher score indicated greater knowledge.
- **Awareness of mpox:** Denotes the familiarity with mpox as a disease, including recognition of its emergence, epidemiology, and public health significance. Awareness was measured through self-reported prior exposure to information about mpox and recognition of the disease in clinical settings.
- **Attitudes towards mpox:** Encompasses the perceptions, beliefs, and feelings of healthcare professionals regarding mpox, such as concern about personal risk, attitudes towards patients with mpox, and willingness to engage in prevention and control efforts. This was evaluated using a Likert-scale questionnaire with statements reflecting positive, moderate and negative attitudes.

Sample size and sampling technique

Sample size determination was based on an estimated population of 441 healthcare workers, comprising physicians (167), nurses (146), pharmacists (45), and medical laboratory scientists (83). Using Raosoft Online calculator at a 95% confidence level, the sample size was calculated to be 206. Accounting for a 10% non-response rate, the final sample size was adjusted to 227 participants. Proportionate allocation was employed to determine the sample size for each healthcare profession (Table 1). A systematic random sampling technique was utilized to select participants. We had access to a full population frame listing all 441 healthcare workers. The sampling interval was calculated by dividing the population size (441) by the sample size (227), resulting in an interval of 2. The starting point for the selection process was the first member on the list, and thereafter, every second individual was selected to participate. This ensured that each healthcare worker had an equal chance of being included in the study, maintaining the integrity of the random selection process and minimizing selection bias.

Instrument for data collection

The data collection instrument used in this study was a 34-item semi-structured self-administered questionnaire, organized into three main sections.

Professional	Population	Sample
Physician	167	$= 227 \times \frac{167}{441}$ approx = 86
Nurses	146	$227 \times \frac{146}{441}$ approx. = 75
Pharmacists	45	$227 \times \frac{45}{441}$ approx = 23
Medical Laboratory Scientists	83	$227 \times \frac{83}{441}$ approx = 43
Total	441	227

Table 1. Proportionate allocation.

Section A: demographic data

This section consisted of 11 questions aimed at gathering demographic information about the participants, including age, gender, years of experience, and professional qualifications.

Section B: knowledge assessment

Comprising 15 questions, this section focused on evaluating the knowledge of healthcare professionals regarding mpox. The questions covered various aspects of the disease, such as its transmission, symptoms, and treatment options. The questions were phrased using a combination of yes/no and multiple-choice formats. Each correct answer was assigned a score of “1,” while incorrect answers received a score of “0.” Participants’ knowledge was categorized as Good (< 50% of total score), Fair (50–69% of total score), or Poor (> 70% of total score) based on their overall score.

Section C: attitude assessment

This section included eight questions rated on a 5-point Likert scale, ranging from strongly agree to strongly disagree. It aimed to explore the attitudes of healthcare professionals towards mpox. Attitudes were categorized as Positive (> 70% of total score), Moderate (50–69% of total score), or Negative (< 50% of total score) based on the total score accumulated from the responses.

Validity and reliability of study instrument

The validity and reliability of the study instrument were ensured through rigorous processes. Face and content validity were evaluated by a panel of six professionals with expertise in Public Health, Medicine, and Clinical Pharmacy. The experts reviewed the questionnaire items for clarity, relevance, and comprehensiveness. The evaluation process involved multiple rounds of review, during which the experts assessed each item based on its relevance to the construct being measured, the appropriateness of the language used, and the coverage of key concepts. Based on the feedback, several items were revised to enhance clarity and ensure alignment with the intended constructs. Recommendations from these experts were incorporated into the questionnaire to enhance its quality. Additionally, a pre-test involving 10 healthcare professionals at Afe Babalola University Multisystem Hospital, Ado-Ekiti, Ekiti state, was conducted to assess the instrument’s suitability and clarity, with adjustments made accordingly.

Reliability was assessed using the Cronbach’s alpha test, which yielded a score of at least 0.75 for each section of the questionnaire, indicating good reliability. The reliability coefficients for each section or subscale are detailed in Table 2.

Data collection and analysis

Data was obtained using a self-administered questionnaire after the synopsis of the study was explained to the participants. Eligibility was determined based on predefined inclusion criteria, and written informed consent was obtained from all participants before their enrolment.

Data analysis was conducted using descriptive statistics, with results presented in percentages, frequencies, tables, and charts for categorical variables. The relationship between knowledge, perception, and associated factors was assessed using chi-square tests and Fisher-Freeman-Halton Exact Test. Additionally, independent sample T-test and one-way analysis of variance (ANOVA) were employed to evaluate statistical differences between categorical variables with two and three groups, respectively. A significance level of 5% was set for all analyses, which were performed using the Statistical Package for the Social Sciences (SPSS) version 27.0.

Ethical consideration

Ethical approval to conduct the study was obtained from Rivers State University Teaching Hospital Ethics committee (RSUTHREC) with approval number RSUTHREC 24–13 before the research was conducted. Participants’ informed consent was obtained before enrollment into the study. The confidentiality of their responses and their anonymity were fully guaranteed. All methods were performed in accordance with the relevant guidelines and regulations.

Results

Socio-demographics of healthcare professionals

A total of 227 healthcare professionals participated in the study, of which 134 (59.0%) were female and 93 (41.0%) were male. The majority were single (123, 54.2%) compared to those who were married (104, 45.8%). Most participants (100, 44.1%) were aged between 20 and 29 years, while 66 (29.1%) were aged 40 years and above. Ethnic backgrounds included Yoruba (15, 6.6%), Igbo (62, 27.3%), Hausa (5, 2.2%), and others (145, 63.9%). Most respondents (215, 94.8%) identified Christianity as their religious affiliation. Regarding professional roles,

Section/Subscale	Number of Items	Cronbach’s Alpha
Section A	11	0.82
Section B	15	0.78
Section C	8	0.75
Overall	34	0.85

Table 2. Reliability coefficients for questionnaire sections and Subscales.

87 (38.3%) were physicians, 23 (10.1%) were pharmacists, 74 (32.6%) were nurses, and 43 (18.9%) were medical laboratory scientists.

In terms of professional experience, 70.8% (247) had 1–5 years of experience, and 24.7% (56) had more than 10 years of experience. Only 45 (19.8%) had received prior training on mpox, while the majority (182, 80.2%) had not. Full details of the socio-demographic characteristics are presented in Table 3.

Knowledge and awareness of healthcare professionals towards mpox

The knowledge and awareness of the healthcare professionals were assessed and 96.9% (220) indicated prior awareness of mpox, while 3.1% had not encountered it before. The primary sources of information on mpox among the respondents who were aware included health professionals (67.2%), internet sources (45.9%), and mass media (41.8%).

When presented with knowledge statements about mpox, 79.3% correctly identified mpox as a viral infection, while 59.9% recognized its potential transmission through a monkey bite. Only 34.4% knew that travelers from America and Europe are not the primary source of imported cases while 72.7% correctly identified similarities between mpox and smallpox symptoms. Only 48.5% knew that there is no specific treatment for mpox.

Misconceptions were evident, with 54.2% believing that individuals vaccinated against chickenpox are immunized against mpox. On the other hand, 88.5% correctly identified the virus as the causative agent of mpox. The knowledge of transmission modes varied, with 79.7% recognizing contact with infected persons or animals, but only 27.8% acknowledging transmission through sexual intercourse.

Based on knowledge scores, 32.2% demonstrated poor knowledge, and 22.5% showed good knowledge (Table 4).

Attitude of Healthcare professionals towards mpox

Table 5. outlines the attitude of healthcare professionals regarding mpox. Majority (61.7%) acknowledged feelings towards its potential as a worldwide pandemic while 89% agreed that mpox could strain the healthcare systems of affected countries. The majority of respondents (87.6%) advocated for the utilization of a mpox

A. Demographics		Frequency (N = 227)	Percent
Gender	Male	93	41.0
	Female	134	59.0
Marital status	Single	123	54.2
	Married	104	45.8
Age [Mean ± SD: 33.88 ± 9.860 years (20–64 years)]	20–29 years	100	44.1
	30–39 years	61	26.9
	40 years and above	66	29.1
Ethnicity	Yoruba	15	6.6
	Igbo	62	27.3
	Hausa	5	2.2
	Others	145	63.9
Religion	Christianity	215	94.8
	Islam	6	2.6
	Others	6	2.6
Additional qualifications	None	62	27.3
	Ph.D.	7	3.1
	MSc.	41	18.1
	Others	117	51.5
Healthcare professional	Physicians	87	38.3
	Pharmacists	23	10.1
	Nurses	74	32.6
	Medical Laboratory Scientists	43	18.9
Years of experience	1–5 years	247	70.8
	6–10 years	102	29.2
	> 10 years	56	24.7
B. Previous training on mpox			
Item		Frequency	Percentage
Have you received or attended training on mpox? (N = 227)	Yes	45	19.8
	No	182	80.2

Table 3. Sociodemographics of Healthcare professionals.

Item (N = 227)	Frequency	Percentage
Have you heard of mpox before?	Yes	220
	No	7
Source of information on mpox (N = 220)*		
Health professional	148	67.2
Internet/online sources	101	45.9
Mass media	92	41.8
Friends/Family	38	17.3
Others	3	1.3
Knowledge statements (N = 227)		
Statement	Correct responses	Percentage
Mpox is a bacterial disease infection Correct Answer: No	180	79.3
Mpox can be transmitted through a bite of an infected monkey Correct Answer: Yes	136	59.9
Travelers from America and Europe are the primary source of imported cases of mpox Correct Answer: No	78	34.4
Mpox and small pox have similar signs and symptoms Correct Answer: Yes	165	72.7
There is no specific treatment for mpox Correct Answer: Yes	110	48.5
People who got the chickenpox vaccine are immunised against mpox Correct Answer: No	123	54.2
Mpox is more prevalent in Western and Central Africa Correct Answer: Yes	148	65.2
Antibiotics are used to treat human mpox Correct Answer: No	124	54.6
Pregnant women are at increased risk for severe mpox infection Correct Answer: Yes	113	49.8
The causative agent for mpox infection Correct Answer: Virus	201	88.5
The average incubation period of mpox infection Correct Answer: 7–14 days	93	41.0
Group at higher risk of getting Mpox infection Correct Answer: Elderly	16	7.0
Mode of transmission of mpox*		
Contact with infected person or animal	181	79.7
Contact with body lesions, body fluids, respiratory droplets	164	72.2
Contaminated beddings and towels	107	47.1
Sexual intercourse	63	27.8
Score	Frequency (%)	Remark
< 50%	73 (32.2)	Poor knowledge
50–69%	103 (45.4)	Fair knowledge
≥ 70%	51 (22.5)	Good knowledge

Table 4. Knowledge and awareness of Healthcare professionals towards mpox. Mean knowledge score \pm SD (range): 8.82 ± 2.992 (2–15) Total obtainable score: 16

vaccine once available. Similarly 96.5% believed that early detection of the mpox virus could greatly improve treatment outcomes.

Concerning preventive measures, a significant proportion (93%) acknowledged the potential influence of mass media coverage on mpox prevention while 95.6% of respondents emphasized the importance of adherence

S/N	Statement	Responses (%)					Median
		SA	A	N	D	SD	
1	I have bad feelings toward the mpox virus that it might become a worldwide pandemic	52 (22.9)	88 (38.8)	42 (18.5)	33 (14.5)	12 (5.3)	A
2	I think that mpox can add a new burden on the healthcare system of the affected countries	106 (46.7)	96 (42.3)	17 (7.5)	6 (2.6)	2 (0.9)	A
3	In my opinion, the mpox vaccine should be used when available	132 (58.1)	67 (29.5)	19 (8.4)	8 (3.5)	1 (0.4)	SA
4	In my opinion, the early detection of mpox virus can improve treatment and outcome	172 (75.8)	47 (20.7)	6 (2.6)	2 (0.9)	-	SA
5	I think that mass media coverage of mpox may influence its prevention	152 (67.0)	59 (26.0)	7 (3.1)	7 (3.1)	2 (0.9)	SA
6	In my opinion, mpox can be reduced by following the appropriate guidelines	145 (63.9)	72 (31.7)	6 (2.6)	2 (0.9)	2 (0.9)	SA
7	I am concerned about the potential spread of mpox within my community/region	77 (33.9)	99 (43.6)	34 (15.0)	8 (3.5)	9 (4.0)	A
	Score	Frequency (%)			Remark		
	0–49%	-			Negative Attitude		
	50–69%	126 (55.5)			Moderate Attitude		
	70–100%	101 (44.5)			Positive Attitude		

Table 5. Attitude of Healthcare professionals towards mpox. Key: SA = Strongly Agree-5; A = Agree-4; N = Neutral-3; D = Disagree-2; SD = Strongly Disagree-1.

to guidelines in reducing mpox transmission. A minority of respondents (37.5%) expressed worry about mpox spreading within their communities or regions.

Overall, the healthcare professionals showed a moderate to positive attitude towards mpox, with 55.5% holding moderate views and 44.5% expressing positive attitude towards the disease.

Differences in knowledge scores based on demographics, previous training and awareness of mpox

Male healthcare professionals exhibited a higher mean knowledge score compared to their female counterparts, with statistical significance (p -value = 0.003). Also, professionals aged over 40 demonstrated the highest mean knowledge score, followed by the 30–39 age group and those aged 20–29. The differences were statistically significant (p -value = 0.008). Furthermore, professionals with more than 10 years of experience had the highest mean knowledge score, followed by those with 6–10 years and 1–5 years. The differences were statistically significant (p -value < 0.001). Additional qualification, while not statistically significant (p -value = 0.145), professionals with a Ph.D. tended to have the highest mean knowledge score than those with other qualifications. The physicians demonstrated significantly higher knowledge scores compared to pharmacists, nurses, and medical laboratory scientists (p -value = 0.002). Also, those who had received training on mpox had substantially

higher mean knowledge scores compared to those without training, with statistical significance (p -value < 0.001) (Table 6).

Relationship between demographics, and attitude of Healthcare professionals

Table 7 presents an analysis of the relationship between demographic variables and the attitude of healthcare professionals towards mpox. There was no significant association between gender and attitude towards mpox (p -value = 0.587). Both male and female professionals demonstrated similar attitude, with moderate attitude (MA) slightly higher among females. Also, age groups did not show a significant relationship with attitude towards mpox (p -value = 0.335). Similarly, years of experience did not significantly influence attitude towards mpox (p -value = 0.193). The presence of additional qualifications did not significantly impact attitude towards mpox (p -value = 0.365). There was no significant association between profession and attitude towards mpox (p -value = 0.691).

Discussion

Mpox is a zoonotic viral disease that remains a significant public health concern due to its potential to cause widespread outbreaks, particularly in endemic regions like Nigeria. Understanding the socio-demographic characteristics, knowledge, and attitudes of healthcare professionals toward mpox is critical for effective disease management, prevention, and containment. This study aimed to assess these aspects among healthcare professionals to identify gaps and inform targeted interventions.

The demographic profile revealed a predominance of females, single individuals, and those aged 20–29 years. The physicians comprised of the largest professional group while most participants reported 1–5 years of experience in their respective fields. The healthcare professionals have a different profile to a study by Ajayi and colleagues where majority of the healthcare professionals had greater than 5 years' experience, were married and were female²⁵. This could be slightly due to differences in the category of healthcare professionals enrolled in the two studies. Our study findings included physicians, pharmacists, nurses and medical laboratory scientists compared to the comparative study that involved only physicians and nurses.

Regarding mpox awareness, the vast majority of participants were familiar with the disease, with healthcare professionals, internet sources, and mass media cited as primary information sources. These findings are similar to those reported by Awoyomi et al. (2023)¹⁸ where more than 95% of the healthcare professionals were aware of the disease. When comparing these findings with a systematic review conducted on mpox awareness among healthcare professionals globally, it is evident that knowledge levels vary significantly based on the region's exposure to the disease. A meta-analysis by Tanashat et al. (2024) on healthcare professionals' knowledge on mpox revealed that while general awareness of mpox was high, specific knowledge about zoonotic transmission and symptoms was often lacking particularly in non-endemic regions²⁶. This knowledge gap was attributed to the healthcare workers' limited experience with mpox cases in these regions. However, compared to the general population, healthcare professionals may have greater disease awareness due to occupational exposure, routine training on infectious diseases, and reliance on professional sources like medical guidelines.

Variables		Frequency (%)	Mean score \pm SD	p -value
Gender	Male	93 (41.0)	9.52 \pm 3.098	0.003**
	Female	134 (59.0)	8.34 \pm 2.828	
Age	20–22 years	100 (44.1)	8.32 \pm 2.863	0.008**
	30–39 years	61 (26.9)	8.64 \pm 3.261	
	≥ 40 years	66 (29.1)	9.74 \pm 2.747	
Years of Experience	1–5 years	136 (59.9)	8.32 \pm 2.933	$P < 0.001^{b*}$
	6–10 years	35 (15.4)	9.66 \pm 2.909	
	> 10 years	56 (24.7)	9.52 \pm 2.979	
Additional Qualification	None	62 (27.3)	8.56 \pm 2.603	0.145 ^b
	PhD.	7 (3.1)	9.86 \pm 3.805	
	MSc.	41 (18.1)	9.68 \pm 2.715	
	Others	117 (51.5)	8.59 \pm 3.189	
Profession	Physician	87 (38.3)	9.75 \pm 2.616	0.002**
	Pharmacists	23 (10.1)	7.96 \pm 3.254	
	Nurses	74 (32.6)	8.51 \pm 2.931	
	Medical Lab Scientists	43 (18.9)	7.93 \pm 3.247	
Had previous training on mpox	Yes	45 (19.8)	10.27 \pm 2.783	$P < 0.001^{a*}$
	No	182 (80.2)	8.46 \pm 2.941	
Heard about mpox before	Yes	220 (96.9)	8.86 \pm 2.965	0.212 ^a
	No	7 (3.1)	7.43 \pm 3.735	

Table 6. Differences in knowledge scores based on demographics, previous training and awareness of mpox. Key: SD: standard deviation; a: independent sample T-test; b: one way analysis of Variance; *: statistically significant value, $p \leq 0.05$.

Variables		Frequency (%)	Attitude		p-value
			MA	PA	
Gender	Male	93 (41.0)	54	39	0.587 ^a
	Female	134 (59.0)	72	62	
Age	20–22 years	100 (44.1)	50	50	0.335 ^a
	30–39 years	61 (26.9)	37	24	
	≥ 40 years	66 (29.1)	39	27	
Years of Experience	1–5 years	136 (59.9)	69	67	0.193 ^a
	6–10 years	35 (15.4)	23	12	
	> 10years	56 (24.7)	34	22	
Additional Qualification	None	62 (27.3)	29	33	0.365 ^b
	Ph.D.	7 (3.1)	5	2	
	MSc.	41 (18.1)	23	18	
	Others	117 (51.5)	69	48	
Profession	Physicians	87 (38.3)	44	43	0.691 ^a
	Pharmacists	23 (10.1)	13	10	
	Nurses	74 (32.6)	44	30	
	Medical Lab Scientists	43 (18.9)	25	18	
Had previous training on mpox	Yes	45 (19.8)	27	18	0.509 ^a
	No	182 (80.2)	99	83	
Heard about mpox before	Yes	220 (96.9)	121	99	0.466 ^b
	No	7 (3.1)	5	2	

Table 7. Relationship between demographics, awareness and attitude of health professionals towards on mpox. Key: ^a: Chi-Square test; ^b: Fisher-Freeman-Halton test; MA: Moderate Attitude; PA: Positive Attitude.

In Nigeria, mpox is now recognized as endemic, making awareness among healthcare professionals crucial²⁷. Our study revealed that despite widespread awareness, 3.1% of healthcare professionals had no awareness of mpox. This gap in awareness could have serious public health consequences. Inadequate awareness among healthcare professionals increases the risk of misdiagnosis or improper treatment²⁸, which can, in turn, exacerbate the spread of the infection. Mismanagement of cases could facilitate the transmission of the disease within Nigeria or to other regions, as infected individuals may travel and unknowingly spread the disease.

Healthcare practitioners might overlook mpox when evaluating patients with symptoms that resemble other viral infections, especially given that direct experience with mpox cases may vary. In Nigeria, where mpox is now considered endemic, direct encounters with cases may still be infrequent for some practitioners, which could hinder timely diagnosis and effective outbreak response²⁷. Addressing these knowledge gaps is essential to improve diagnostic accuracy and ensure proper case management. Our findings highlight the importance of ongoing education and targeted training for healthcare workers, especially in countries like Nigeria that have experienced repeated outbreaks. Such efforts would enhance preparedness for future outbreaks and strengthen the capacity of healthcare professionals to prevent further spread of the disease. Despite the high level of awareness, the study highlighted several gaps in knowledge. When presented with knowledge statements, majority correctly identified mpox as a viral infection and recognized its potential transmission through a monkey bite. This is similar to findings in a study in North and Southern Nigeria where 92.9% and 70.3% reported mpox to be caused by a virus and being sexually transmitted respectively¹⁸. This study also showed that only 22.5% of healthcare professionals had good knowledge of mpox which is in contrast to findings by Awoyomi et al. (2023)¹⁸ and Shafei et al. (2023)²⁹ where 67.3% and 70.3% of healthcare professionals had good knowledge of mpox in Nigeria and Saudi Arabia respectively. These differences may stem from various factors, including the availability and effectiveness of training programs, the prevalence of mpox cases, and overall healthcare system preparedness. The higher knowledge levels in regions like Saudi Arabia could be attributed to more robust healthcare training and ongoing educational initiatives focused on infectious diseases, which may not be as prevalent in Nigeria. A meta-analysis by Tanashat et al. (2024) indicated that 41% of healthcare professionals demonstrated good knowledge of mpox, with lower knowledge levels observed among professionals in regions with limited exposure to mpox cases²⁶. This underscores the need for targeted educational strategies, particularly in countries like Nigeria, where mpox is now considered endemic. Although Nigeria has faced multiple outbreaks, comprehensive training frameworks for healthcare professionals are still developing. Addressing this knowledge gap is essential to ensure healthcare practitioners are well-prepared for future cases. Integrating discussions on emerging and re-emerging zoonotic diseases, including mpox, into mandatory continuing education programs can effectively bolster knowledge and preparedness among healthcare workers.

Analysis of knowledge scores revealed variations among participants, with a considerable proportion demonstrating poor knowledge. Factors such as gender, age, years of experience, professional qualification, and previous training on mpox significantly influenced knowledge levels. Male professionals, those aged over 40, with 6–10 years of experience, physicians and previous mpox training exhibited statistically significant higher knowledge scores. The findings were similar to findings by Shafei and colleagues where professionals aged 40

years and above, attended conferences or lectures on mpox, and general practitioners were more likely to have good knowledge than those of lower years, who did not attend conferences, and other healthcare professionals respectively²⁹. Conversely, Shafei and colleagues also indicated that females were more likely to have good knowledge than males while those with 1–5 years were more likely to have good knowledge than those above 5 years.

The study finding suggests a gender disparity in mpox knowledge among healthcare professionals, highlighting the need for targeted educational interventions to address this gap. Also, the association between age and knowledge may be attributed to greater professional experience and exposure to educational opportunities over time. Furthermore, the difference in knowledge based on years of experience underscores the importance of cumulative experience in enhancing knowledge acquisition and retention among healthcare professionals. This study also indicates that physicians tend to have more comprehensive knowledge of infectious diseases due to their specialized training and clinical experience.

Healthcare professionals who had undergone specific training on mpox exhibited significantly greater knowledge levels compared to those without such training. This highlights the efficacy of targeted educational initiatives in improving awareness and understanding of mpox among healthcare professionals.

It is essential to note that while certain demographic and professional factors may contribute to higher knowledge scores, addressing knowledge gaps among all healthcare professionals remains critical to effective mpox management and prevention strategies. Therefore, targeted educational programs tailored to the specific needs of different professional groups and demographic profiles are warranted to enhance mpox knowledge and improve overall disease outcomes. In the general population, education level, socioeconomic status, and urban vs. rural residence are stronger determinants of knowledge levels than professional experience³⁰. For healthcare professionals, the professional development environment including conferences, peer interactions, and patient case experiences plays a pivotal role in maintaining and expanding knowledge.

The attitudes of healthcare professionals towards mpox revealed several key insights, with 44.5% demonstrating a positive attitude. This is higher than findings from a global systematic review, which reported that only 34.6% of healthcare workers held a positive attitude towards mpox¹⁶. The more positive attitudes among healthcare professionals in this study may be attributed to several factors. One key factor could be Nigeria's recent designation as an endemic region for mpox. This status, along with regional proximity to other outbreak-prone areas, likely heightens healthcare professionals' awareness and concern. As an endemic country, Nigeria's healthcare workers may feel a greater responsibility to address the disease proactively.

Additionally, exposure to mpox cases, either directly or through knowledge of local outbreaks, may further influence these attitudes. Even infrequent encounters with mpox cases can foster more cautious and proactive approaches among healthcare professionals, supporting efforts to manage and contain the disease effectively.

Furthermore, perception of professional responsibility could play a significant role in shaping attitudes³¹. Healthcare professionals in Nigeria may feel a stronger obligation to be vigilant against infectious diseases like mpox due to past experiences with other viral outbreaks, such as Ebola and COVID-19. This heightened sense of duty to prevent and control zoonotic diseases may contribute to a more engaged and positive attitude toward mpox-related public health measures.

A majority recognized the potential for mpox to evolve into a worldwide pandemic. This is dissimilar to findings by Amer et al. (2024)¹⁷ where just over 18% healthcare professionals agreed to expect mpox leading to another pandemic like COVID-19. Our study findings indicate a high level of concern regarding the disease's global impact. Additionally, a significant proportion acknowledged the strain that mpox could impose on healthcare systems in affected countries, highlighting the potential public health challenges associated with managing the disease.

Furthermore, there was strong support for preventive measures and interventions among healthcare professionals. The vast majority advocated for the utilization of mpox vaccine once available. A similar finding was reported by Mektebi and colleagues in a systematic review of 10 studies involving 7322 healthcare professionals from Asian, African, Northern American and European countries where 58.5% of the professionals opted for vaccine acceptance when available³². This underscores the importance of vaccination in controlling and preventing the spread of the disease, especially among those directly involved in patient care.

While healthcare professionals generally exhibit high vaccine acceptance rates, regional and contextual variations are notable. For instance, in regions where mpox is endemic, or where healthcare workers have experienced outbreaks firsthand such as in parts of Central and West Africa, vaccine acceptance is typically higher³². This increased acceptance may be driven by the perceived risk of contracting the disease and a firsthand understanding of its public health impact. Conversely, in regions where mpox is not endemic, vaccine acceptance tends to be more modest, underscoring the need for targeted educational initiatives in these areas. Such initiatives are crucial to ensure healthcare workers recognize the importance of vaccination, even in regions with fewer reported cases.

Another crucial factor in vaccine acceptance among healthcare professionals could be past experiences with vaccination, particularly during the COVID-19 pandemic. The pandemic highlighted the critical role vaccines play in outbreak control, and healthcare professionals, having been on the front lines, largely trust vaccines' benefits. This positive past experience could have likely bolstered support for new vaccines, such as the one for mpox. However, it is also worth noting that vaccine fatigue or concerns over the rapid introduction of vaccines during COVID-19 might contribute to hesitancy in some professionals³³. Addressing such concerns is important to maintain high acceptance rates for mpox vaccines. Effective professional education can significantly enhance vaccine acceptance, as seen in the positive relationship between higher knowledge levels and willingness to accept vaccines³⁴.

Healthcare professionals are not only recipients of vaccines but also key advocates for public vaccination efforts³⁵. Their acceptance and endorsement of the mpox vaccine can significantly influence the general

population's willingness to get vaccinated. As trusted sources of health information, healthcare workers can help bridge the gap in vaccine hesitancy among the broader community. Therefore, promoting vaccine acceptance among healthcare workers is vital for ensuring the success of public health interventions aimed at controlling mpox and mitigating its impact on healthcare systems.

The positive attitude toward the mpox vaccine among healthcare professionals underscores the potential for public health campaigns to leverage this support in encouraging broader community acceptance of the vaccine. Additionally, as healthcare professionals act as role models for vaccination, increasing their knowledge and addressing hesitancy can have a ripple effect, leading to higher vaccine uptake among the general public³⁶. Ultimately, increasing vaccine acceptance among healthcare professionals is crucial for enhancing preparedness, preventing outbreaks, and ensuring the resilience of healthcare systems.

In terms of preventive measures, healthcare professionals recognized the potential influence of mass media coverage on mpox prevention, with 93% acknowledging its significance similar to findings in Saudi Arabia³⁷. This underscores the importance of effective communication strategies and public health campaigns in raising awareness and promoting preventive behaviors among the population. Additionally, majority emphasized the importance of adherence to guidelines in reducing mpox transmission, highlighting the role of strict adherence to infection control measures and protocols in preventing the spread of the disease within healthcare settings and communities.

The sources of information on mpox among healthcare professionals in this study (primarily health professionals (67.2%), internet sources (45.9%), and mass media (41.8%)) underscore the vital role that information channels play in shaping knowledge and attitudes toward the disease. In a systematic review by León-Figueroa et al. (2024), which examined information sources among healthcare professionals across different countries, it was found that internet sources were the most frequently cited source of information, followed by mass media²⁰. This suggests that while the internet is a dominant global source of information, professional networks and peer interactions remain an essential and trusted resource, particularly in regions like Nigeria. This could be due to the fact that peer information is perceived as more reliable or specific to the clinical context, allowing healthcare professionals to exchange practical knowledge based on direct experience³⁸. The trust placed in professional colleagues as a primary source of information likely stems from the desire for accurate and clinically relevant knowledge. This trust could also account for why healthcare professionals in this study exhibit a relatively higher level of positive attitudes toward mpox compared to other global regions. Peer exchanges allow for more nuanced and context-specific discussions that may not always be available through mass media or internet sources³⁸.

The role of internet sources, such as online medical platforms and databases, has also been highlighted in several studies as a key driver of self-directed learning among healthcare professionals^{37,39}. The reliance on internet sources by some health professionals in this study mirrors this global trend, suggesting that healthcare workers increasingly turn to online platforms for the latest updates and information on emerging diseases. The immediacy and accessibility of internet-based information can influence both knowledge acquisition and attitudes by providing up-to-date data on outbreaks, symptoms, and prevention strategies⁴⁰.

However, while these sources are critical in enhancing knowledge, they can also contribute to misinformation if not carefully vetted⁴¹.

Implications for public health

The findings from this study have significant implications for public health, particularly in enhancing the management and prevention of mpox among healthcare professionals. Firstly, the observed gaps in knowledge among healthcare workers underscore the urgent need for targeted educational initiatives. By implementing training programs that focus on zoonotic diseases, transmission dynamics, and clinical presentation, public health authorities can enhance healthcare professionals' readiness to identify and manage mpox cases effectively.

Moreover, the study reveals a moderate level of vaccine acceptance among healthcare professionals, which is a promising indicator for public health campaigns aimed at promoting vaccination. Encouraging healthcare workers to advocate for vaccination within their communities can help build public trust and increase overall vaccine uptake. Given the role of healthcare professionals as trusted sources of information, their positive attitudes toward vaccination can significantly influence public perception and acceptance of mpox vaccination.

Additionally, the identified primary sources of information (health professionals, internet resources, and mass media) highlight the critical role of effective communication strategies in shaping knowledge and attitudes. Public health campaigns should leverage these sources to disseminate accurate and timely information about mpox, thereby reducing misinformation and enhancing awareness. Engaging healthcare professionals in these campaigns can amplify their impact and ensure that accurate messages reach wider audiences.

Furthermore, the findings of this study can inform policy decisions aimed at improving healthcare infrastructure and resources dedicated to infectious disease management. Policymakers should consider the educational and support needs of healthcare professionals to ensure they are equipped to handle emerging infectious diseases effectively.

Strengths and limitations of study

This study possesses several notable strengths that enhance its significance in the field of public health.

Firstly, the diversity of the participant group is a major strength. By including a broad range of healthcare professionals, the study offers a comprehensive perspective on mpox awareness, knowledge and attitude across different professional backgrounds. Secondly, by focusing on healthcare professionals at Rivers State University Teaching Hospital, the study addresses a specific context often underrepresented in existing research. This localized approach provides valuable insights into the unique challenges and experiences faced by healthcare workers in Nigeria, making the findings particularly relevant for public health initiatives within the country.

Moreover, the timeliness of this research adds to its strength. As public health concerns about the resurgence of mpox, the study contributes timely and relevant data that can inform ongoing public health strategies. Its findings can assist in developing educational programs and interventions aimed at improving healthcare professionals' readiness to manage emerging health threats.

In addition, the study's comprehensive assessment of knowledge, attitudes, and vaccination intentions highlights its multifaceted approach. By not only evaluating knowledge levels but also exploring attitudes toward vaccination, the research provides a more complete picture of the factors influencing healthcare professionals' preparedness to respond to Mpox effectively. This study lays a solid foundation for future research. By identifying specific knowledge gaps and attitudes towards vaccination, it highlights areas that warrant further investigation. The findings can serve as a springboard for larger, multi-site studies or longitudinal research aimed at enhancing healthcare professionals' understanding of mpox and informing public health responses.

While our study provides valuable insights into mpox knowledge and attitudes among healthcare professionals at Rivers State University Teaching Hospital, several limitations must be acknowledged regarding the methods employed.

Firstly, our sampling method, although utilizing a systematic random approach, relied on a sample from a single healthcare facility. This may introduce sampling bias, as the findings may not be fully representative of the broader population of healthcare professionals in Rivers State or Nigeria. Also, conducting the study at a single healthcare facility may limit the generalizability of our findings, as responses and perspectives among healthcare professionals may vary across different settings in Rivers State or Nigeria. However, the findings can serve as a background for further studies in the area.

Secondly, the data collection relied on self-administered questionnaires, which could introduce response bias. Participants may provide socially desirable responses or inaccurately represent their knowledge and attitudes towards mpox, potentially affecting the validity of our findings.

Additionally, the cross-sectional design used in our study provides a snapshot of data at a single point in time. While useful for describing prevalence and associations, it does not allow for the examination of changes over time or the establishment of causal relationships between variables.

Suggestions for future studies

Future research should aim to include a broader sample of healthcare professionals from various healthcare settings across Nigeria to enhance the generalizability of the findings. Additionally, studies could investigate the effectiveness of targeted educational interventions designed to improve knowledge and attitudes toward Mpox and its vaccination. It would also be beneficial to explore the impact of real-world experience with Mpox cases on healthcare professionals' knowledge and attitudes. Understanding how previous outbreaks influence readiness to adopt preventive measures, such as vaccination, can inform future public health strategies.

Conclusion

This study provided valuable insights into the socio-demographics, knowledge, and attitudes of healthcare professionals towards mpox. The findings revealed a high level of awareness among participants, with significant knowledge gaps regarding the disease's transmission and treatment. Healthcare professionals also demonstrated moderate to positive attitudes towards mpox. Factors such as gender, age, years of experience, professional qualification and previous training on mpox significantly influenced knowledge levels, but did not influence attitude in the study participants highlighting the importance of targeted educational interventions.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Author contributions

EO and GA conceptualised the study. EO analysed and interpreted the patient data. GA collected data from the patients. OO, TB, TA, AS, BJ, and AA reviewed the manuscript. All authors approved the final version of manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

Ethical clearance was obtained from Rivers State University Teaching Hospital Research Ethics Committee (RSUTHREC) with approval number RSUTHREC 24 – 13 before the research was conducted. Participant eligibility was assessed based on study inclusion criteria after which a written informed consent was obtained before enrolment into the study. The confidentiality of the information they gave was maintained. All methods were performed in accordance with the relevant guidelines and regulations.

Additional information

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