



# Re-emergence of monkeypox virus outbreak in Nigeria: epidemic preparedness and response (Review-Commentary)

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## Abstract

The re-emergence of the monkeypox virus has come with many burdens on nations. This is partly after the effects of the coronavirus disease 2019 virus is subsiding. The burden of the monkeypox virus is seen even more in developing and third-world countries. Beyond the monkeypox virus re-emergence, there have also been several other viruses within the world and in Nigeria. This study assessed Nigeria's preparedness and response to the re-emergence of the monkeypox virus. The Nigerian Government showed its preparedness in the fight against the monkeypox virus by bringing together both Human and Animal Health Sectors. It ensured interventions and programs were created. Among these is Surveillance Outbreak, Response, Management, and Analysis System, a Surveillance and monitoring intervention to manage any outbreak. A second intervention is the Emergency Operation Center. It is recommended that vaccines should be made available, personnel should be adequately trained, and improved diagnostics equipment be made available. Nigeria has had cases of the monkeypox virus, and we wanted to see how far it has come in its preparedness and how it will respond if the need arises. This study reviewed existing literature on Nigeria's battle against the monkeypox virus in times past, the actions taken, and the programs developed.

**Keywords:** re-emergence, monkeypox virus, preparedness, response, Nigeria

## Introduction

Monkeypox disease is caused by infection with the Monkeypox Virus (MPXV). It is a zoonotic disease and an orthopoxvirus with symptoms similar, but less severe, to smallpox<sup>[1]</sup>. The virus's first appearance is said to have been around the 1950s in laboratory Monkeys. The first human case confirmed; however, was in 1970

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## HIGHLIGHTS

- In 2017, Nigeria's level of preparedness was revealed when the Nigeria Center for Disease Control activated the Emergency Operation Center.
- From the knowledge it had gathered, Nigeria Center for Disease Control created the Surveillance Outbreak, Response, Management, and Analysis System. This further boosted on time reporting and responses.
- Subsequently, the 'National Multisectoral Emergency Operations Center' for monkeypox was activated with a focus on strengthening responses within the country.
- The decrease in smallpox vaccination has limited Nigeria's effective response against the monkeypox virus.

in the Democratic Republic of Congo (DRC)<sup>[2]</sup>. Two forms (clades) of the MPXV are known currently; the West Africa Clade and the Central Africa Clade, or the Congo Basin Clade. The West Africa Clade is known to be less severe and has limited human-to-human transmission<sup>[3]</sup>. MPXV shows several signs and symptoms (varying degrees of severity), including headache, fever, fatigue, low energy, muscle ache, and lymphadenopathy<sup>[1]</sup>. MPXV prevalence is high in central and west Africa. However, the sudden increase in the number of cases reported in other countries, including Europe and America, poses a significant threat to the global health sector<sup>[4]</sup>; this has led to the WHO declaring it as a Public Health Emergency of International Concern<sup>[1]</sup>. As of 22 August 2022, over 42 000 monkeypox cases

were reported, with 12 deaths in over 90 countries across the globe<sup>[5]</sup>. This study aims to present several pressing concerns regarding the preparedness of the Nigerian healthcare sector toward the re-emergence of the monkeypox virus and the response to this outbreak.

In 1958, Von Magnus *et al.* observed monkeys' first case of a nonfatal pox-like virus. This virus was isolated, and since it appeared to be different from other known pox viruses, it was named monkeypox. After this initial case, there were five other outbreaks of the monkeypox virus among monkeys in the following years, prompting the WHO to survey 26 major biological institutions using a large number of monkeys to study the virus<sup>[6]</sup>. The first human monkeypox case was discovered in a 9-month-old child in the DRC in 1970<sup>[6]</sup>. In DRC (then Zaire), a country in Central Africa where smallpox got eliminated in 1968, two cases suspected to be smallpox were recorded in 1970, one of which was confirmed to be chickenpox. The other was the first occurrence of human monkeypox, discovered in an infant. Since then, the virus has become endemic in the Congo and has spread to other nations at an alarming rate<sup>[6,7]</sup>. It was discovered that numerous species of monkeys inhabited the affected areas and served as a source of food for the people<sup>[6]</sup>.

In six African countries, DRC (Nigeria, Liberia, Sierra Leone, Cote d'Ivoire, and Cameroon), 59 human infections were recorded between 1970 and 1980<sup>[8]</sup>. From 1980 to 1986, over 400 cases were reported in Central and West Africa, all found in tropical rainforest locations. However, between 1972 and 1981, the instances in Congo where monkeypox was first reported vastly outnumbered those reported from any other country, increasing significantly from 1982 to 1984<sup>[7]</sup>. Most recorded cases of monkeypox in Africa are said to have been transmitted by deaths animals, which include rodents and less through human-human transmission. The possibility of transmission through the respiratory or mucocutaneous and inoculation or percutaneous routes or both were recorded<sup>[9]</sup>.

The first case in Nigeria was recorded in 1971<sup>[10]</sup>. Nevertheless, until the outbreak in 1996, the most common mode of virus transmission was contact with small animals in the rainforest<sup>[8]</sup>. A study of etiology and the sequencing of genomes; however, revealed several cases of human-human transmission in Nigeria<sup>[11,12]</sup>. Human monkeypox cases have been recorded in 11 African countries: the DRC, Benin, the Central African Republic, Cameroon, Nigeria, the Republic of Congo, Ivory Coast, Liberia, Sierra Leone, Gabon, and South Sudan<sup>[13]</sup>. The first incidence of the virus outside of Africa was during an epidemic in the United States in 2003, which was traced back to imported West African rodents<sup>[14]</sup>. Monkeypox infection cases in the United Kingdom in 2018 and 2019, Israel in 2019, and Singapore in 2019 were all traced back to travelers from Nigeria<sup>[15]</sup>.

The most threatening virus outbreak in West Africa occurred in Nigeria between September and November 2017. Data collected in 2017 showed that 88 cases were confirmed, and since then, Nigeria has been reporting new cases<sup>[3]</sup>. From its re-emergence in September 2017 to August 2018, the South-South region reported the highest number of cases. Nigeria recorded 262 suspected and 113 confirmed cases in 26 states and seven deaths in 16 states<sup>[16]</sup>. Eight to 49 human monkeypox cases were recorded annually between 2019 and 2021. Nigeria had its lowest number of reported cases in 2020 since the outbreak in 2017, with only eight recorded instances<sup>[17]</sup>. Disease outbreaks are affected by factors such as geography

location, population size, travels between places, infectious disease levels within the locality and the public behavior<sup>[18]</sup>. A one health approach adoption is of great significance seeing that it will help us track quickly animal-human and human-animal risk associated with diseases. Managing the emergence and re-emergence of infectious diseases in the future with knowledge from this current outbreak through the isolation of potential reservoirs, studying infections pattern and changes in severity, and the right management of vaccination will become easier<sup>[9]</sup>.

Bunge EM *et al.* recorded that the total number of human monkeypox cases has increased dramatically in this sequence, with the highest being: in the DRC, Nigeria, and the Central African Republic<sup>[12]</sup>. Over the last 50 years, the average age of reported MPXV infection is said to have increased, rising from 4 years in the 1970s to 21 years in the 2010s. These trends, according to research, are most likely linked to smallpox vaccine cessation and a decline in cross-immune protection against the monkeypox virus. According to a 2016 study conducted in Nigeria, the immunization rate of the population had dropped to 10.1%, and the immune protection fell from 65.6% in the 1970s to 2.6%; the vaccination rate had alarmingly declined to 9.3% by 2018, and the population immunity level was just 2.2%<sup>[19]</sup>.

## Nigeria's preparedness against the monkeypox outbreak

The close partnership between the human and animal health sectors to effectively respond after defining an outbreak, to prevent and control its spread within their regions, and globally defines what epidemic preparedness is. On 22nd September 2017 with the monkeypox outbreak in Nigeria, the Nigeria Center for Disease Control (NCDC) showed its preparedness by activating the Emergency Operation Center: a multidisciplinary agency. This boosted the control of monkeypox spread<sup>[20-22]</sup>. By the end of the 2017 outbreak in Nigeria, the NCDC had created the Surveillance Outbreak, Response, Management, and Analysis System. It aims to aid timely and complete case reports to boost the detection, prevention, and control of monkeypox and other diseases with an enhanced response. This project assisted in the real-time reporting of data. This project also included training District Surveillance Notifications officers and Laboratory staff. Contact tracing and suspected outbreaks were transmitted via surveillance outbreak, response, management, and analysis system, and positive cases were recorded<sup>[23]</sup>. To further boost strength, the 'National Multisectoral Emergency Operations Center for MonkeyPox' was activated on 26 May 2022. As a Level 2 project, its focus is to coordinate and strengthen in-country responses and activities and, at the same time, contribute to the global fight<sup>[24]</sup>.

## Nigeria's response so far

### Previous responses

After the diagnosis carried out on the first patient at NDUTH (Niger Delta University Teaching Hospital), an 11 year old boy, a multisectoral, international outbreak investigation was undertaken to confirm the suspected case, identify sources and risk factors, establish surveillance, and enhance preparedness<sup>[21,25]</sup> Figure 1.

The monkeypox outbreak at NDUTH was plagued by delayed diagnosis due to the lack of adequate laboratory

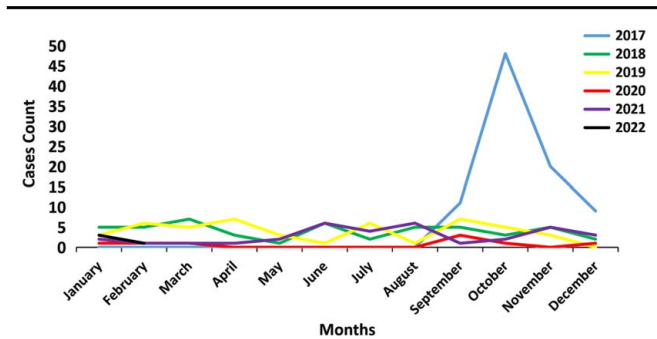


Figure 1. Nigeria confirmed monkeypox cases by the year of incidence-September 2017–February 2022<sup>[14]</sup>.

capacity in Nigeria. The hospital’s response was hampered by this challenge, leading to a sequence of events<sup>[25]</sup>. The most notable events spanning from the admission of the first or index case to the discharge of the last case are better shown in Figure 2 below.

This timeline outlines the key events that transpired during the human monkeypox outbreak at NDUTH, from the identification of the initial case to the eventual discharge of the last patient following successful treatment Figure 3.

Later, 38 suspected cases were found at the NDUTH, of which 21 met the case definition for human monkeypox. Clinical and laboratory investigations were conducted, and it was discovered

that the significant clinical symptoms of the 21 cases, other than skin rash, were fever, skin itching, headache, and lymphadenopathy<sup>[25]</sup>.

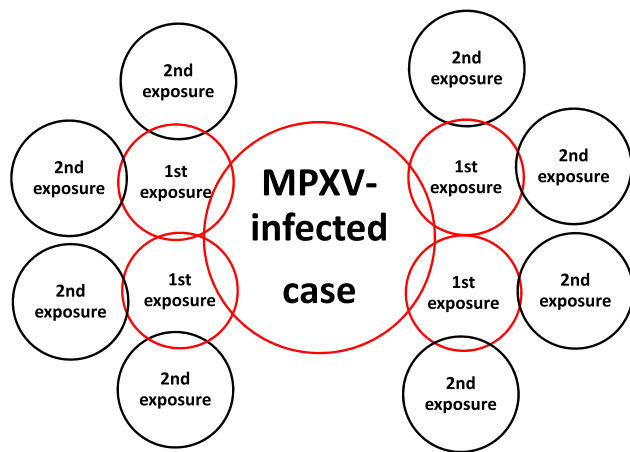
An infection control committee comprised of an infectious disease specialist, a public health physician, an infection control nurse, and microbiologists already existed before the initial phase of the outbreak. When the outbreak occurred, the NDUTH had no designated isolation infrastructure for suspected monkeypox patients. The unavailability of isolation infrastructure prompted the hospital to accommodate adult male and female cases in different sections with separate toilet facilities using the 12-bed medical ward<sup>[25]</sup>. About a week after the confirmation of the outbreak, a Rapid Response Team was deployed from the NCDC to Bayelsa State to support the state government in responding, investigating, and containing the outbreak. Subsequently, the NDUTH was designated as the treatment center for all suspected cases of Monkeypox<sup>[26]</sup>. The NCDC prepared an incident action and the Interim National Guidelines to guide the outbreak response. A protocol for animal active monkeypox surveillance was developed, targeting high-risk areas at the human–animal interface<sup>[20,21]</sup>.

**New responses**

The monkeypox virus outbreak is of global concern. Hence, an adequate response and preparedness plan is of great importance. Thus, recent responses have been made by the NCDC, FDA (Food and Drug Administration), and EMA<sup>[5]</sup>. Cases of Monkeypox were reported in several States in Nigeria in 2021;



Figure 2. A flowchart of the significant events of the human monkeypox outbreak at Niger Delta University Teaching Hospital<sup>[22]</sup>. FMOH, Federal Ministry of Health; HCW, Health care workers; NCDC, Nigeria Center for Disease Control.



**Figure 3.** Implementation of ring vaccination as a strategy to control monkeypox outbreaks<sup>[29]</sup>.

such states include Lagos, Rivers, Delta, Edo, Ogun, Bayelsa, and the Federal Capital Territory. The responses so far include diagnosis (genetic methods, phenotypic methods, immunological methods, and electron Microscopy methods), while treatment includes vaccination and the use of antivirals<sup>[27]</sup>.

**Management**

MPXV can be diagnosed through the use of an Electron microscope. However, this method is not definitive because Orthopoxvirus cannot be differentiated morphologically<sup>[28]</sup>. Immunologically, through the use of ELISA, the viral antigen can be detected. The immunological method can distinguish between viruses<sup>[29]</sup>. There is also a phenotypic method for its diagnosis that revolves around signs and symptoms<sup>[29,30]</sup>.

It can be prevented through:

**Vaccination**

When a contact tracing was done in the 1980s for MPXV an infection rate of 7.2% for unvaccinated and 0.9% for vaccinated individuals was recorded<sup>[31,32]</sup> Research has shown cross-protection of the MPXV from the Smallpox vaccines: The Sanofi Pasteur Biologics Co. vaccine (ACAM2000) and that manufactured by Bavarian Nordic A/S (JYNNEOS). This cross-protection is not just peculiar to MPXV but also to other Orthopoxvirus species<sup>[32,33]</sup>. Monkeypox is a highly infectious disease with the potential to cause outbreaks and even pandemics. The monkeypox vaccine and ring vaccination can effectively break the chain of transmission and prevent severe disease during outbreaks. This strategy is particularly effective when implemented early in outbreaks. The vaccine for monkeypox has been shown to be effective in protecting against the disease, and ring vaccination can enhance this protection. However, the successful implementation of ring vaccination depends on addressing challenges such as limited vaccine supply and ensuring preparedness in affected areas. Despite these challenges, ring vaccination remains a critical strategy in containing the spread of monkeypox<sup>[34]</sup>.

By vaccinating the close contacts of confirmed cases, ring vaccination can help prevent the spread of the disease and also prevent severe cases from occurring. This has been used during the Ebola outbreak<sup>[32]</sup>.

**Antiviral agents**

For MPXV, no specific cure can be said to be available. However, it has been managed through supportive care and treating its symptoms<sup>[33,35]</sup>.

Emphasis must be made on strict observation of public health safety measures to limit the spread of monkeypox disease nationwide. Genomic sequencing is ongoing at NCDC’s National Reference Laboratory to identify possible mutations and the epidemiology of the virus. There is a need for collaboration with WHO and the United States Center for Disease Control for a global stockpile of monkeypox vaccination<sup>[36,37]</sup>.

**Limitations to the response**

Some factors, like the monkeypox virus outbreak, must be evaluated before planning any outbreak response. If correctly assessed, then interventions are expected to succeed. These factors were the source of limitations to the monkeypox response.

**Rapid population growth**

It is crucial to consider the population these strategies are to serve while planning an outbreak response like monkeypox<sup>[22]</sup>. It is sound and logical that the increase in reported monkeypox cases results from increased population density<sup>[38]</sup>. A retrospective review of case records of 40 HMPX admitted in various states in Nigeria between September 2017 and December 2018 showed that, unlike previous studies in which fever was recognized as the first symptom of monkeypox, a majority reported skin rash as the first symptom<sup>[39]</sup>.

**Decrease population immunity**

A study using data from the Nigeria Center for Disease Control and Prevention, World Bank data, and the Nigeria National Bureau of Statistics showed that a significant decline in immunity in Nigeria’s population was observed before an increase in monkeypox cases in 2017 (Table 1). On this basis, a logical linkage was made between a decrease in immunity to smallpox and the resurgence of monkeypox in Nigeria<sup>[19]</sup>.

**Inadequate diagnostic capacity**

Infectious diseases like monkeypox require polymerase chain reaction laboratory capabilities. It is plausible and logical that

**Table 1**  
**Epidemiological summary of monkeypox virus in Nigeria from 2017 to 2022**

Key Indicators	Number
Total confirmed cases from January to 28 February 2022	4
Total cases reported from 2017 to 2022	525
Total deaths 2017–2022	8
Total confirmed cases in 2017	88
Total confirmed cases in 2018	49
Total confirmed cases in 2019	47
Total confirmed cases in 2020	8
Total confirmed cases in 2021	34
Total confirmed cases in February 2022	1

improving diagnostic capabilities is prioritized<sup>[22]</sup>. Also, there is no vaccine currently licensed for use against monkeypox<sup>[40]</sup>.

### **Technological limitations**

From the onset of the monkeypox outbreak, low awareness of the outbreak would affect the response negatively. The re-emergence of monkeypox in Nigeria in 2017, although unusual, may be the consequence of several control gaps in the spillover process driven by a combination of factors that warn immunity among vaccinated individuals was a factor<sup>[41]</sup>.

## **Recommendations**

### **Administration of monkeypox vaccines**

According to a recent report, countries such as the United States of America and the United Kingdom have started vaccinating contacts with monkeypox cases and healthcare workers; however, no African country has commenced vaccination against monkeypox<sup>[42]</sup>. In line with recommendations outlined by WHO, we advise that the Nigerian government expedite the procurement of monkeypox and smallpox vaccines, followed by administering these vaccines to the target population, which includes cases, contact of cases, laboratory workers, and other frontline personnel<sup>[43]</sup>. A recent study reported that about one million vaccines expired due to a lack of uptake<sup>[44]</sup>. To tackle this issue, we recommend that the government disseminate accurate information about vaccines to the public because a significant cause of vaccine hesitancy is the prevalence of conspiracy theories<sup>[44]</sup>.

### **Provision of adequate diagnostic facilities**

Before the 2014 Ebola virus outbreak, the virology laboratory at Lagos University Teaching Hospital was well equipped with adequate diagnostic tools; the successful response to the outbreak is attributable, in part, to this factor. Conversely, the response to the monkeypox outbreak in 2017 by the NCDC and the Ministry of Health was greatly hampered by the lack of adequate testing facilities at NDUTH; this affected the rapid testing of cases presented to the hospital<sup>[22]</sup>. Furthermore, we suggest an increase in the number of rapid testing facilities across states in the country to help ensure timely testing and detection of cases, as this is crucial to curbing the spread of the virus from undetected cases to the public.

### **Capacity building and training of healthcare workers and other relevant personnel**

The successful mounting of a response to the monkeypox outbreak in Nigeria largely depends on the adequate training of healthcare personnel, epidemiologists, biostatisticians, etc.<sup>[25]</sup>. During the Monkeypox outbreak in 2017, it was observed that several healthcare workers were hesitant to get involved in response to the outbreak. This reluctance was; however, overcome by repeated training of healthcare personnel<sup>[45]</sup>.

### **Increase in knowledge about monkeypox among healthcare workers and the public**

Research conducted in the Republic of Congo showed high levels of belief in the artificial introduction of the virus into the

community. At the same time, some lacked a belief in the existence of the virus<sup>[46]</sup>. A study conducted in Nigeria reported the prevalence of conspiracy beliefs about monkeypox among South Southerners and South-Easterners<sup>[47]</sup>. An increase in disseminating accurate knowledge from credible sources through outlets such as newspapers, radio, and billboards will help increase knowledge levels about the disease<sup>[48,49]</sup>.

## **Conclusion**

Monkeypox virus is rapidly re-emerging in Nigeria, with a tremendous increase in mortality rates across different states. It is necessary to understand MPXV infection re-emergence, its capacity to develop, and the imposed danger of death due to the infection.

Awareness programs on the danger MPXV post, its mode of transmission, and possible host that can transfer it to humans should be carried out. The fact that it has no treatment or vaccine should also be made known to the public. Furthermore, it is also vital that provisions for meat inspection law be laid down and enforced. These rules should require animal consumption purposes to be adequately checked before even reaching the abattoir.

## **Ethical approval**

Not applicable.

## **Consent**

Not applicable.

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None.

## **Author contribution**

N.D.P.: conceptualization, project administration, resources, supervision, validation, writing – original draft, writing – review and editing; P.A.: conceptualization, supervision, validation, writing – original draft, writing – review and editing; O.O. and O. K.O.: resources, writing – original draft; P.O.: methodology, resources, writing – original draft, writing – review and editing; A.I.A. and A.P.O.: writing – original draft; D.J.O., O.A.A., E.S. E., A.M.O., O.S.A., and Q.O.K.: resources, writing – original draft.

## **Conflicts of interest disclosure**

We will like to declare that this work has no conflicting interest.

## **Research registration unique identifying number (UIN)**

This was not a human study.

## Guarantor

Danladi Nengak Precious and Progress Agboola.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

## Data availability statement

Data Sharing is not applicable.

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