



Monkeypox: A Possible Zoonotic Threat

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Abstract

Monkeypox (Mpox) is an emerging zoonotic disease caused by the Monkeypox virus (MPXV), a double-stranded DNA virus of the *Orthopoxvirus* genus. The disease shares clinical similarities with smallpox but manifests with lower severity. Since its first identification in monkeys in 1958 and the initial human case in 1970, Mpox has transitioned from being a sporadic, endemic disease in Central and West Africa to a global public health concern, with the largest multi-country outbreak occurring in 2022. Mpox transmission occurs through animal-to-human contact and human-to-human spread via respiratory droplets, bodily fluids, and contaminated materials. Two major viral clades—Clade I (Central African) and Clade II (West African)—differ in virulence and transmission dynamics. Recent epidemiological data reveal rising cases linked to environmental changes, urbanization, and waning immunity following the cessation of smallpox vaccination. Diagnosis primarily relies on polymerase chain reaction (PCR) and serological tests, with rapid test kits now improving field detection. Although Mpox is generally self-limiting, antivirals and supportive care are recommended. Preventive strategies emphasize surveillance, vaccination, and adherence to infection control measures. The WHO's Global Strategic Preparedness and Response Plan (SPRP) focuses on enhancing global collaboration, research, and vaccine accessibility. Strengthening public health systems, advancing diagnostic technology, and promoting community awareness remain vital to curbing future Mpox outbreaks.

Keywords: Monkeypox virus, zoonosis, epidemiology, diagnosis, prevention, global health

1. INTRODUCTION

Monkeypox virus (MPXV) is a double-stranded DNA virus in the *Poxviridae* family, Subfamily *Chordopoxvirinae*, genus *Orthopoxvirus* (Moss *et al.*, 2013). Mpox is a large, oval-shaped enveloped virus (Okwor *et al.*, 2023). Mpox is a zoonotic disease with an unknown primary host that can affect humans (Alakunl, 2020). The disease presents symptoms similar to smallpox but with lesser severity. In recent years, Mpox has acquired increased attention due to outbreaks outside endemic areas, with the largest multi-country outbreak occurring in 2022. Mpox surveillance strategies should include early detection of cases, tracing of all close contacts of confirmed cases, and protecting high-risk populations to prevent transmission (CDC, 2022).

2. HISTORY

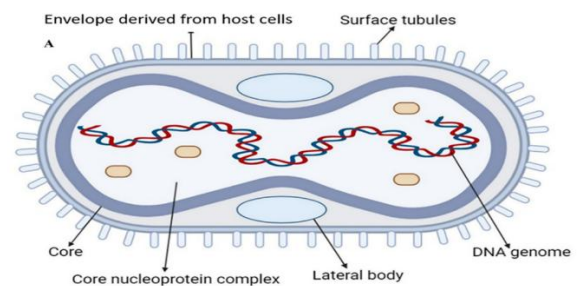
In 1958, Mpox was first described among monkeys shipped from Singapore to Denmark during an outbreak of a smallpox-like disease in Denmark. The first case of Mpox infection in humans was reported in 1970 in the Democratic Republic of the Congo involving a 9-year-old boy during the smallpox vaccination campaign. In 1970-1990 Over 400 cases were reported, predominantly in rural tropical rainforest regions of Central and West Africa, especially in the DRC. The eradication of smallpox in 1980 significantly impacted Mpox in Central and West Africa, as smallpox vaccination campaigns ended (Jezek *et al.*, 1987). In 2003 a mpox outbreak occurred in the United States, These outbreaks 1st time seen outside of Africa. This outbreak was traced when infected animals were brought from Ghana to the U.S. (47 confirmed cases). In 2017 Nigeria experienced a significant Mpox outbreak in 2017. Unvaccinated people are affected. Five hundred (500) suspected cases and 200 confirmed cases have been reported. The largest global outbreak of Mpox occurred in 2022, when the virus spread rapidly outside of Africa, affecting more than 100 countries, including many in Europe, North America, and

beyond. A new strain of the virus Clade Ib, began spreading rapidly in the DRC and neighboring countries. WHO to declare a Public Health Emergency of International Concern in August 2024 (WHO, 2024).

3. ETIOLOGY

Mpox is caused by the monkeypox virus, which has been found in various monkeys and rodents. While the primary reservoir host is still unknown, the African rodents are considered potential hosts in endemic regions of Africa (CDC, 2022). Techniques like molecular assays and virus isolation have also identified susceptibility in animals such as prairie dogs, African hedgehogs, and nonhuman primates (Silva *et al.*, 2022). Mpox virus enters the host body through the respiratory tract, skin and mucous membrane, fomite transmission, Animal bites, or scratches (McCollum *et al.*, 2014).

Structure of Monkeypox Virus:



Virus Types:

Based on clinical presentation and genomic sequencing results, Mpox virus isolates were classified into two clades.

Clade?

In biology, a clade is a group of organisms with a common ancestor (Heymann *et al.*, 1998).



Clade I: Central Africa, High fatality rates (1–12%) and more severe illness, including death, compared to Clade II.

Clade II: In West Africa, Fatality rates less than 0.1%, Milder in its impact. (Hymann *et al.*, 1998).

Clade I:

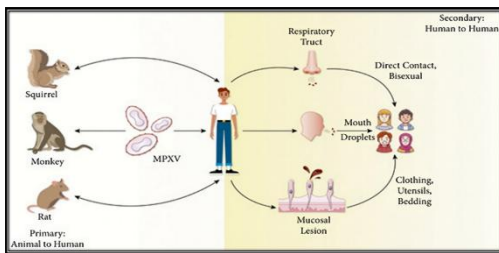
1. **Clade Ia:** Central Africa, Infected dead or live wild animals, In children younger than 15 years of age.
2. **Clade Ib:** DRC, Adult close physical contact, In adults.

Clade II:

- i. West Africa, Mostly through animal-to-human transmission.
- ii. Spread globally (outbreak 2022), Spread through human-to-human transmission (Isidro *et al.*, 2022).

4. TRANSMISSION & PATHOGENESIS

1. Transmission:



Primary Transmission: Animal to Human:

Direct or indirect contact by handling infected animals, Animal blood, bodily fluids, and lesions, eating undercooked meat, residing near a forested area (Reynolds *et al.*, 2003).

Secondary Transmission: Human to Human:

Direct or indirect contact by respiratory droplets, contact with clothing or other fabrics, and vertical transmission (Heskin *et al.*, 2022).

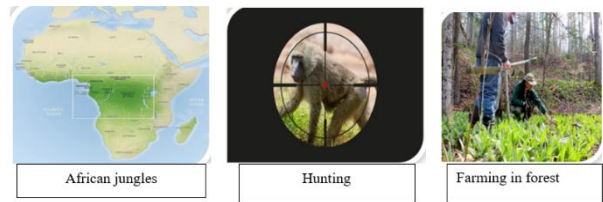
2. Pathogenesis:

The incubation period is 4 to 21 days. Once the Mpox virus is exposed to an individual, it uses particular membrane proteins on its surface to bind to and infiltrate into host cells.

One of the first places it enters is the lymph nodes, and then will enter into the blood leading to the initial viremia stage of infection. The virus will eventually lead to symptoms after an approximately 4-21-day incubation period. Symptoms involve a flu-like prodromal stage of the disease, with a subsequent pox-like rash that occurs with vesicles and pustules (Kaler *et al.*, 2022).

5. EPIDEMIOLOGY

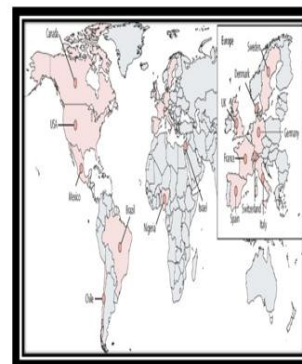
A common area where Mpox virus is seen:



Climate and Ecological changes

Over the past 30 to 40 years, the Congo Basin and Central Africa regions have experienced significant changes in annual precipitation due to human activities like deforestation, agricultural expansion, and urbanization (Nakazawa *et al.*, 2013). These changes affect the interactions between humans and animals, increasing the likelihood of zoonotic diseases spreading (Hansen *et al.*, 2008). Rope squirrels, which rely on oil palm trees as a primary food source, are commonly found in forests. Their presence near human populations poses a significant risk factor for Mpox transmission (Fuller *et al.*, 2011).

Distribution in World, 2022



Distribution in India, 2022



Mpox was first discovered in 1958 after two outbreaks of a pox-like illness in monkeys at the Statens Serum Institute in Denmark. The virus was named "monkeypox" because it was first identified in captive monkeys imported from Singapore for polio vaccine research (Magnus *et al.*, 1959). Mpox was identified as a separate disease in 1970 after smallpox was eradicated, though similar illnesses persisted in rural areas (Nalca *et al.*, 2005). In 2022, the Centers for Disease Control and Prevention (CDC) confirmed 5,783 cases of Mpox across 52 different countries worldwide. In 2023, Brazil also reported 10,247 cases of Mpox. In 2022, a report from France and Brazil identified a potential case of Mpox in dogs also (Seang *et al.*, 2022).

6. PUBLIC HEALTH SIGNIFICANCE

Distribution in the world, 2024

Area	Number of Reported Confirmed Cases	Number of confirmed Death cases	Which clade affect
DRC	9457	43	Clade I
Burundi	1874	0	Clade I
Uganda	443	1	Clade I
Ghana	2	0	Clade II

(WHO, 2024)

Distribution in India, 2024



As per the Integrated Disease Surveillance Programme 1st week of 2024 Kerala (Thirissur) reported 2 cases, also 38th & 39th week also 1 case of Mpox (IDSP, 2024)



Mpox outbreaks put pressure on healthcare systems, particularly in low-income areas, as hospitals work to manage patients, prevent further transmission, and address other emergencies like COVID-19. Outbreaks can greatly disrupt trade and supply chains, especially if quarantines and restrictions on the movement of goods are implemented. Mpox is less contagious than COVID-19, but it can still impact trade, particularly in agriculture and livestock, as it spreads through contact with infected animals like rodents and primates (CDC, 2023). Mpox outbreaks pose challenges in distinguishing the disease from chickenpox and other herpesvirus infections, complicating diagnosis and treatment (Mukherjee *et al.*, 2023). India urgently needs better public health strategies and crisis management plans to control the rise of Mpox and related *orthopoxvirus* infections. The absences of affected workers have significantly impacted productivity, especially in sectors such as healthcare, service, and retail, where remote work is not possible (Mukherjee *et al.*, 2023)

7. SYMPTOMS



The incubation period of monkeypox varies from 5 to 21 days. Fever, lymphadenopathy, muscle pain, and headache are seen in the predormal stage which is seen in 0 to 2 days. Skin rashes are seen in the rashes stage or eruptive stage which is seen in 7 to 21 days (McCollum and Damon, 2014).

8. DIAGNOSIS

1. Viral isolation:

The virus can be cultured from patient samples in specialized laboratories, but this method is not routinely used due to safety concerns (Eagle's Minimal Essential Medium (EMEM) used).

2. Immunohistochemistry:

This test detects specific *Orthopoxvirus* antigens in biopsy specimens.

3. Polymerase chain reaction (PCR):

PCR is the most reliable method for confirming monkeypox. It detects the virus's DNA in samples taken from skin lesions, blood, or other bodily fluids.

4. Serological test:

This can detect antibodies against the monkeypox virus

(Alakunle *et al.*, 2020).

Rapid Test Kit

In 2024, new diagnostic technologies greatly enhanced the rapid detection of Mpx during outbreaks. JOYSBIO successfully developed rapid test kits for detecting Mpx virus antigens and antibodies.



Monkeypox Antigen Negative: A colored band appears on the control line (C line); no colored band on the test line (T line).

Monkeypox Antigen Positive: A colored band appears on the control line (C line) and the test line (T line).



Monkeypox IgM Positive: colored bands appeared on M and C line

Monkeypox IgG Positive: colored bands appeared on G and C line

Monkeypox Antibody Negative: only colored bands appeared on the C line



Differential Diagnosis:

Clinical presentation	Monkeypox	Chickenpox	Measles
Fever	1 to 3 days before the appearance of rash	1 to 2 days before the appearance of rash	3 to 5 days before to the appearance of rash
Leison	Singular phase	Numerous phase	Numerous phase
Dermal signs	Appears late	Appears early	Appears early
Rash distribution	Much denser in the face, palm	Not present in the palm and soles	Starts from the face and then moves to the extremities
Lymphadenopathy	Present	Absent	Rare

(Kaler *et al.*, 2022)

9. TREATMENT

The clinical management of Mpx includes offering general supportive care and administering antiviral medications.



The disease typically resolves within 2 to 4 weeks as the host develops immunity, making it a self-limiting condition. Patients with extensive anogenital ulcers or abscesses need drainage, debridement, and wound management. Antibiotics are prescribed to treat secondary bacterial infections (Grosenbach *et al.*, 2018).

10. PREVENTION AND CONTROL

To prevent the spread of Mpox to others, individuals with Mpox should isolate at home as directed by their healthcare provider. Wash your hands frequently with soap and water or hand sanitizer, particularly before and after touching sores. Health workers must wear personal protective equipment (PPE) and adhere to safety protocols when caring for Mpox patients,



(WHO, 2024)

including properly swabbing lesions and safely handling needles (Mahmoud and Nchasi, 2023).

Vaccine

- 1) JYNNEOS (live attenuated vaccine) is a two-dose vaccine effective against Mpox and smallpox, with both doses required for optimal protection after exposure. The second dose is administered four weeks after the first. Approved in the USA, Canada, and Europe.
- 2) LC16-KMB (live attenuated vaccine) (licensed in Japan) and
- 3) OrthopoxVac (live attenuated vaccine) (licensed in the Russian Federation)

India has not issued any advisory on Mpox vaccination at present (Rizk *et al.*, 2022).

Surveillance Outline in India

1. Use of Standard Case Definitions by all stakeholders
2. Even a single case of Mpox is considered an outbreak, requiring detailed investigation, including contact tracing, which must be conducted urgently by all stakeholders.
3. Immediate reporting to the DSU/State Surveillance Units (SSUs) and the Central Surveillance Unit (CSU) will inform the Directorate General of Health Services.
4. Samples should be sent to designated laboratories as per guidelines, and the IDSP must maintain records of all samples sent for testing and their results (NCDC, 2024)

Mpox Global Strategic Preparedness and Response Plan (SPRP), 2024

This will be achieved by:

1. Surveillance and response strategies.
2. Advancing research and improving access to medical countermeasures.
3. Minimizing zoonotic transmission.

- Empowering communities to actively participate in the prevention and control of outbreaks.

SPRP works at various levels:

- From September 2024 to February 2025, the plan focuses on stopping the spread of Clade Ib in eastern DRC and nearby countries, while managing Clades I and II outbreaks in areas like DRC and Nigeria.
- The SPRP emphasizes enhanced surveillance, swift detection, and rapid response in high-risk areas, alongside global collaboration to improve vaccine access in low- and middle-income countries (WHO, 2024).

Stop outbreaks of human-to-human transmission:

- Quickly identify and manage outbreaks effectively.
- Advanced Mpox research access to countermeasures.
- Minimize the zoonotic transmission.

11. CONCLUSIONS

Mpox primarily occurs in the jungles of central and western Africa. The disease is a typical zoonosis, occurring mainly through direct contact with infected animals, unlike smallpox. The etiological agent of Mpox is the monkeypox virus (MPXV), a double-stranded DNA virus. The disease's symptoms sometimes cause vesiculopustular rashes; thus, rapid and accurate laboratory diagnostics are essential for controlling an outbreak. The WHO has confirmed two distinct clades of the Mpox virus: clade I and clade II. In November 2003, the CDC and FDA banned the import, sale, and transport of African rodents, dogs, and other animals to prevent the spread of Mpox in the U.S.

WHO has released the Mpox Global Strategic Preparedness and Response Plan (SPRP) to minimize human-to-human transmission. Serological tests, rapid kit tests,

immunohistochemistry, and PCR are used for the diagnosis of disease.

12. FUTURE PROSPECTS

Coordinated and multidisciplinary global efforts are essential to contain and prevent future outbreaks of monkeypox. Large-scale health awareness campaigns should be conducted to educate people on reducing contact with potential animal reservoirs and avoiding the consumption of undercooked meat. Enhanced healthcare systems, vaccination initiatives, and effective outbreak response mechanisms will help reduce the virus' impact in endemic regions. The future of Mpox relies on ongoing international cooperation, particularly in providing resources to low-income areas where the virus is prevalent. Collaborative efforts to fund research, enhance healthcare infrastructure, and tackle zoonotic diseases will be essential.

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