New Microbes and New Infections 62 (2024) 101466

Contents lists available at ScienceDirect

New Microbes and New Infections

journal homepage: www.journals.elsevier.com/new-microbes-and-new-infections

Editorial

Global Mpox outbreak: Are we prepared for emerging strains?

The global health community is facing a pressing challenge with the resurgence and mutation of monkeypox virus (MPXV), the causative agent of Mpox (formerly known as monkeypox). MPXV is an *Orthopoxvirus* that shares its family with smallpox and cowpox viruses [1]. Mpox was first identified in monkeys in 1958 and in humans in 1970. Unlike smallpox, Mpox is zoonotic, primarily transmitted from animals like rodents, and exhibits significant environmental stability. Though its mutation rate is low, it adapts through genetic diversity and recombination [2]. Characterised by symptoms like fever, swollen lymph nodes, and a distinctive rash that progresses to scabbing, Mpox as a zoonotic disease can also spread between humans. The 2022 multi-country outbreak was characterized by the sexual transmission especially among men who had sex with men (MSM), it also spreads through direct contact with lesions, bodily fluids, respiratory droplets, or contaminated materials [1,3]. The incubation period ranges from 5 to 21 days, and symptoms typically last 2–4 weeks, with at risk populations being the immune compromised and elderly [4]. Historically, the disease remained endemic to Central and West Africa, where sporadic cases mostly resulted from contact with small mammals [5]. However, since smallpox eradication and the cessation of routine vaccinations, Mpox incidence has increased globally. The first human case was reported in the early 1970s in the Democratic Republic of the Congo (DRC), where the virus remained largely confined until 2022. In 2022, there was a significant shift in the epidemiology of Mpox with the spread of MPXV to countries previously unexposed to sustained transmission. The 2022–2023 outbreak primarily affected MSM in Europe and North America, indicating a shift in the virus's epidemiology [5]. However, other countries had also reported Mpox including among travels and other groups [6–8].

Two genetically distinct clades of Mpox virus exist. Clade I (Central African Clade) is highly infectious, spread by close contact, including among children <15 years of age, and has higher severity and mortality (3–4%), and is ppidemic in DRC since November 2023. Clade II (West African Clade) is the predominant clade in global outbreak 2022–2023, this clade has a lower mortality rate (<1 %) and has greater reach.

In 2022, the World Health Organization (WHO) declared Mpox as a Public Health Emergency of International Concern (PHEIC), spurring efforts to vaccinate at-risk populations and deploy antiviral treatments [9]. On 13 August 2024, the Africa Centers for Disease Control and Prevention (Africa CDC) declared Mpox as a Public Health Emergency of Continental Security (PHECS). This was the first time the agency made such a declaration since it was established in 2017. This was followed by the day after, the WHO declaring Mpox as a PHEIC [10].

Thus, Mpox remains a global concern, particularly in the DRC, which reported over 16,789 (suspected n = 14,151; confirmed n = 2638) cases and 548 deaths in 2024 [11] of clade I (clades Ia, Ib). Clade Ia (also known as clade I) have been reported in nearby countries of, Republic of the Congo, Cameroon, the Central African Republic, whilst clade Ib has spread to Rwanda, Burundi, Uganda and Kenya. Additionally, Sweden recorded its first case of the new Mpox variant, clade 1b in a returned traveller who had visited DRC [11,12]. Pakistan also detected three cases of Mpox in individuals returning from the UAE, though the specific clades are under investigation [13]. These developments highlight the virus's expanding reach beyond traditional endemic regions (Table 1, Fig. 1). The newly identified strain, clade Ib, has become the focal point in the 2024 outbreak. In the DRC, this variant has disproportionately affected children, with 66 % of the total cases occurring in those under 15 with 82 % mortality [14]. Crowded refugee camps further exacerbate transmission risks, emphasizing the need for targeted interventions [15–17].

1. What have we learnt, what are we doing?

The WHO's PHEIC declaration emphasizes the need for a comprehensive international response. The lessons learned from the 2022 outbreak highlight the importance of swift action to prevent further escalation. Efforts are underway to accelerate vaccine access, especially for low-income countries, while an emergency funding requirement of $15 million has been initiated to support containment measures [10].

Experts stress pre-exposure vaccination for at-risk groups like healthcare workers and those in outbreak areas. Improved surveillance is also critical to detect and manage cases effectively. Delayed diagnosis and inadequate response could lead to wider epidemics, particularly as the new clade 1b strain continues to spread. The African region remains the hardest hit, with the DRC accounting for a significant portion of cases. However, underreporting, and limited diagnostic infrastructure means the true burden is likely underestimated.

Genomic analyses reveal around 50 single nucleotide polymorphisms (SNPs) in Clade 1b strain, reflecting a 6-12-fold increase in mutation rate compared to previous strains (11). Many of these mutations involve genes linked to virulence, host recognition, and immune evasion, likely contributing to the strain's enhanced transmission, and altered clinical presentation. The clade 1b variant's rapid spread and severe impact highlight the necessity for coordinated international action [18].

The WHO aims to mobilize resources for surveillance, diagnostics, and vaccination, especially in low-resource settings. The organization's emergency funding appeal highlights the urgency of addressing the outbreak's impact on vulnerable populations, particularly in Africa. Improved equity in health responses, viewing healthcare as a human right, remains a critical focus to ensure that low-income regions receive

https://doi.org/10.1016/j.nmni.2024.101466
Received 19 August 2024; Accepted 20 August 2024
Available online 23 August 2024

Table 1
Global Spread and Impact of the 2024 Mpox Outbreak [10,14]: Rising Cases and emerging clades.

Region/Country	Date of Reporting	Key Developments	Number of Cases (2024)	Deaths (2024)	Notable Information
Democratic Republic of the Congo (DRC)	January 2023–August 2024	WHO declared mpox a Public Health Emergency of International Concern (PHEIC) on August 14, 2024. Ongoing outbreak since January 2023.	16,789	548	Clade I (Ia) and Clade Ib Clade Ib spread to Uganda, Burundi, Rwanda and Kenya by end of July 2024
Sweden	August 15, 2024	First known case of the newer Mpox variant (clade 1b) outside Africa reported. Case linked to a recent stay in an African region where the variant is spreading.	1	0	Reported the new clade 1b variant a day after WHO declared a public health emergency.
Pakistan	August 16, 2024	Three cases detected. Patients returned from the UAE.	3	0	Two cases confirmed in Khyber Pakhtunkhwa, with one awaiting confirmation at the National Health Institute. Clade not yet known
Republic of the Congo (Congo) the Central African Republic (CAR)		Congo (19 confirmed, 150 suspected) CAR (35 confirmed, 223 suspected)			Clade 1a (Congo and CAR); also reported cases in 2023 Suspected cases in South Sudan Cameroon has also reported Clade Ia in addition to Clade II
South Africa, Cote d'Ivore	8 May to 5 August 2024	Common in young males	24 6	3 0	Different clade to the current outbreak. The clade confirmed to be clade II Other African Countries reporting clade II cases (2022–2024): Liberia, Ghana, Benin, Nigeria, Cameroon, Mozambique, Sudan, Egypt
The previous Global Outbreak	2022–2023	116 countries	99,388 (2022–2023)	208 (2022–2023)	Clade II, largely spread through sexual contact

The extent of case under-reporting and under-ascertainment in affected countries is unclear but presumed significant. Therefore, the reported case numbers likely underestimate the true infection rate.

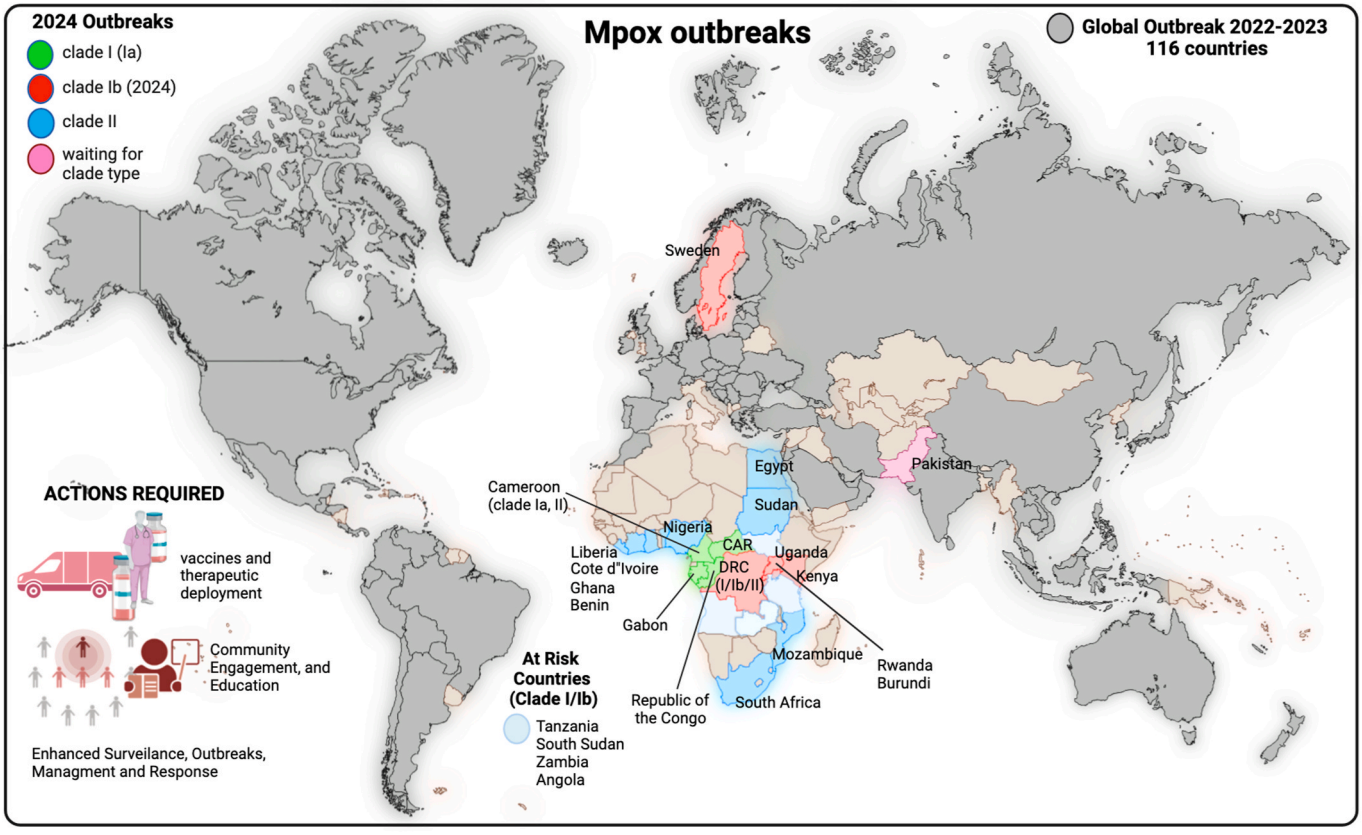

Fig. 1. Mpox 2024 outbreaks in Africa and outside Africa has resulted in the WHO to declare a Public Health Emergency of International Concern (PHEIC). Coloured areas show clade Ia (commonly referred as clade I, green), the highly infectious clade Ib (red) and, clade II (the dominant clade in the 2022–2023 outbreak, blue). In addition, other global countries affected, primarily with clade II, are shown in grey. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

the support they need. The ongoing Mpox outbreak, marked by the emergence of the clade 1b variant, presents a critical challenge for global health.

2. Actions required

The ongoing Mpox outbreak necessitates robust control measures to prevent the virus from evolving into a more potent human infection. If actions are left unchecked, the outbreak could have far-reaching consequences, threatening global health security and disproportionately affecting vulnerable communities [19]. These actions should be implemented by affected countries but also non-affected countries [11,20]. Current strategies should include.

1. To reduce the global spread of Mpox, thus controlling the outbreak in affected African countries is crucial. Essential measures include enhancing contact tracing, improving diagnostic capabilities, and expanding vaccination efforts. To address the Mpox outbreak in Africa, the European Commission's HERA will donate 175,420 doses of the FDA- and EMA-approved Modified Vaccinia Ankara - Bavarian Nordic (MVA-BN®) vaccine. Bavarian Nordic will add 40,000 doses. The Africa CDC will manage distribution according to regional needs [21].
2. The use of antivirals like tecovirimat and brincidofovir may help in the management of Mpox infection. These drugs inhibit the replication of the virus. A combination therapy had also been suggested [22].
3. Expanding vaccination coverage is critical, with a focus on postexposure prophylaxis and prioritising vaccination for healthcare workers and high-risk individuals. Efforts should include vaccinating residents in areas with active Mpox transmission.
4. Effective management of the outbreak depends on enhanced global surveillance systems.
5. A One-health approach is essential to tackle zoonotic threats and understand transmission pathways.
6. Reaching high-risk groups is essential. Key messages should include recognizing Mpox symptoms, getting tested, avoiding sex and close contact until symptoms resolve, and seeking vaccination if available. In areas with significant Mpox activity, public advisories should address the risks associated with sexual contact. Those exhibiting symptoms should seek medical care and avoid close contact until they are diagnosed, or their symptoms have resolved. Risk communication and community engagement are vital.
7. Suspected cases should be isolated until their symptoms have resolved.
8. Developing informational materials and raising awareness among healthcare workers and clinicians is necessary.
9. Effective contact tracing is crucial for managing the outbreak.
10. Avoidance of mass gatherings is important to prevent further spread of Mpox.
11. Avoid contact with wild animals to reduce the risk of Mpox transmission.
12. Implementing genomic surveillance of MPXV is vital for tracking viral evolution and spread. All positive samples should be sequenced and shared publicly, particularly if there are significant changes in virulence, disease presentation, or diagnostic accuracy.
13. Laboratory testing is necessary to identify MPXV and determine its clade type

2.1. Impacts on global economy and tourism

The declaration of Mpox as a PHEIC has the potential to disrupt tourism and local economies. Although the WHO has indicated that travel restrictions and border closures are ineffective in preventing the spread of Mpox, these measures can still have a significant impact. A decline in tourism could severely affect local businesses reliant on visitors, leading to considerable revenue losses. Additionally, the economic burden is heightened by the costs associated with public health interventions and containment strategies. Affected countries face a complex challenge of managing the outbreak while simultaneously dealing with decreased economic activity and escalating financial pressures in both health and economic sectors [23,24].

3. From neglect to urgency: could this be a reason for the next global pandemic?

The recent surge in Mpox cases highlights a critical lesson: diseases once deemed "someone else's problem" can rapidly escalate into global health emergencies. Mpox, initially neglected and confined to Africa, surged worldwide in 2022, revealing significant gaps in research and response. Despite increased funding and attention, a more virulent strain now threatens Africa (clade Ib) which was recently reported outside of Africa, emphasizing the need for equitable access to diagnostics, vaccines, and treatments. This situation highlights the necessity for a proactive, global health approach and highlights the importance of investing in disease research and preparedness across all regions [25].

Funding

No funding received.

Ethical approval

Not applicable.

CRediT authorship contribution statement

Ranjit Sah: Conceptualization, Supervision, Writing – original draft. **Shriyansh Srivastava:** Writing – original draft. **Rachana Mehta:** Writing – review & editing. **Sachin Kumar:** Writing – original draft. **Sanjit Sah:** Writing – review & editing. **Aroop Mohanty:** Resources, Writing – review & editing. **Jack Feehan:** Supervision, Writing – review & editing. **Jaffar A. Al-Tawfiq:** Supervision, Writing – review & editing. **Vasso Apostolopoulos:** Supervision, Writing – review & editing.

Declaration of competing interest

The Authors Declare no conflict of interests.

Acknowledgement

None.

References

[1] Chavda VP, Vora LK, Apostolopoulos V. Monkeypox: a new face of outbreak. Expert Rev Vaccines 2022;21(11):1537–40.
[2] Beer EM, Rao VB. A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy. PLoS Neglected Trop Dis 2019;13(10):e0007791.
[3] Reda A, Abdelaal A, Brakat AM, et al. Monkeypox viral detection in semen specimens of confirmed cases: a systematic review and meta-analysis. J Med Virol 2023;95(1):e28250.
[4] Chavda VP, Apostolopoulos V. Rare monkeypox: is it really a threat to the elderly? Maturitas 2022;163:90–1.
[5] Srivastava S, Kumar S, Jain S, et al. The global monkeypox (mpox) outbreak: a comprehensive review. Vaccines (Basel) 2023;11(6).
[6] Assiri AM, Al-Tawfiq JA, Jokhdar HA, et al. Clinical features and outcome of human Mpox (Monkeypox) in Saudi Arabia: an observational study of travel-related cases. J Infect Public Health 2023;16(3):341–5.

[7] Assiri AM, Alserehi H, Abuhasan MY, et al. Epidemiology, clinical presentation, and outcome of mpox: a study of 381 cases in Saudi Arabia. IJID Reg 2024;11:100358.
[8] Sah R, Mohanty A, Abdelaal A, Reda A, Rodriguez-Morales AJ, Henao-Martinez AF. First Monkeypox deaths outside Africa: no room for complacency. Ther Adv Infect Dis 2022;9:20499361221124027.
[9] Laurenson-Schafer H, Sklenovska N, Hoxha A, et al. Description of the first global outbreak of mpox: an analysis of global surveillance data. Lancet Global Health 2023;11(7):e1012–23.
[10] WHO. World Health Organization. WHO Director-General declares mpox outbreak a public health emergency of international concern. 2024, www.who.int/news/item/14-08-2024-who-director-general-declares-mpox-outbreak-a-public-health-emergency-of-international-concern. [Accessed 14 August 2024].
[11] ECDC. European Centre for Disease Prevention and Control. Rapid Risk Assessment. Risk assessment for the EU/EEA of the Mpox epidemic caused by monkeypox virus clade I in affected African countries. 2024, https://www.ecdc.europa.eu/sites/default/files/documents/mpox-risk-assessment-monkeypox-virus-africa-august-2024.pdf. [Accessed 18 August 2024].
[12] WashingtonPost. Sweden detects mpox variant for the first time outside of Africa, 15 August 2024. https://www.washingtonpost.com/health/2024/08/15/mpox-sweden-africa-clade1/. [Accessed 16 August 2024].
[13] FE-Online. Pakistan health authorities confirm mpox cases, says infected persons were returning from UAE. FE Online. 16 August 2024, https://www.financialexpress.com/business/healthcare-pakistan-health-authorities-confirm-mpox-cases-says-infected-persons-were-returning-from-uae-3584280/. [Accessed 18 August 2024].
[14] AfricaCDC. Africa Centres for Disease Control and Prevention (AfricaCDC). Africa CDC epidemic intelligence weekly report. Addis Ababa: AfricaCDC 2024, https://africacdc.org/download/africa-cdc-weekly-event-based-surveillance-report-august-2024/. [Accessed 18 August 2024].
[15] Guan H, Gul I, Xiao C, et al. Emergence, phylogeography, and adaptive evolution of mpox virus. New Microbes New Infect 2023;52:101102.
[16] Hens M, Brosius I, Berens-Riha N, et al. Characteristics of confirmed mpox cases among clinical suspects: a prospective single-centre study in Belgium during the 2022 outbreak. New Microbes New Infect 2023;52:101093.
[17] Orassay A, Berdigaliyev A, Sadvokassova D, et al. Recent advances on human mpox. New Microbes New Infect 2023;51:101066.
[18] Lu J, Xing H, Wang C, et al. Mpox (formerly monkeypox): pathogenesis, prevention, and treatment. Signal Transduct Targeted Ther 2023;8(1):458.
[19] Amer F, Khalil HES, Elahmady M, et al. Mpox: risks and approaches to prevention. J Infect Public Health 2023;16(6):901–10.
[20] Hindu. The Hindu. Union Health Minister Nadda reviews India's preparedness for monkeypox. 2024. 2024, https://www.thehindu.com/news/national/union-health-minister-nadda-reviews-indias-preparedness-for-monkeypox/article68536343.ece/amp/. [Accessed 18 August 2024].
[21] EUReporter. European Commission coordinates procurement and donation of 215,000 vaccine doses from Bavarian Nordic to support Africa CDC in addressing the Mpox outbreak in affected countries in Africa. 2024, https://www.eureporter.co/world/africa/2024/08/15/european-commission-coordinates-procurement-and-donation-of-215000-vaccine-doses-from-bavarian-nordic-to-support-africa-cdc-in-addressing-the-mpox-outbreak-in-affected-countries-in-africa/. [Accessed 18 August 2024].
[22] Li P, Al-Tawfiq JA, Memish ZA, Pan Q. Preventing drug resistance: combination treatment for mpox. Lancet 2023;402(10414):1750–1.
[23] Du M, Sun H, Zhang S, et al. Global epidemiological features of human monkeypox cases and their associations with social-economic level and international travel arrivals: a systematic review and ecological study. Int J Publ Health 2023;68:1605426.
[24] MTDesk. Mpox reaching pandemic levels will cripple global economy, including travel and tourism. Medic Tourism 2024, https://asianmeditour.com/articles/details/Mpox-reaching-pandemic-levels-will-cripple-global-economy-including-travel-and-tourism-1672. [Accessed 18 August 2024].
[25] Preiser W, Baxter C, Nachega JB. Mpox outbreak in Africa was neglected – it could now turn into the next global pandemic. The Conversation 2024. Published 16 August 2024, https://theconversation.com/mpox-outbreak-in-africa-was-neglected-it-could-now-turn-into-the-next-global-pandemic-236893. [Accessed 19 August 2024].

Ranjit Sah[*,1]
SR Sanjeevani Hospital Kalyanpur, Siraha, Nepal

Shriyansh Srivastava[**,1]
Department of Pharmacy, School of Medical and Allied Sciences, Galgotias University, Greater Noida, 203201, India
Department of Pharmacology, Delhi Pharmaceutical Sciences and Research University (DPSRU), Sector 3 Pushp Vihar, New Delhi 110017, India

Rachana Mehta
Dr. Lal Path Labs Nepal, Chandol, Kathmandu, Nepal
Clinical Microbiology, RDC, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, 121004, India
Medical Laboratories Techniques Department, AL-Mustaqbal University, 51001, Hillah, Babil, Iraq
E-mail address: mehtarachana89@gmail.com.

Sachin Kumar
Department of Pharmacology, Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi,110017, India
E-mail address: sachinsodan@gmail.com.

Sanjit Sah
Department of Pediatrics, Dr. D.Y. Patil Medical College Hospital and Research Center, Dr. D.Y. Patil Vidyapeeth, Pune, 411018, Maharstra, India
Department of Public Health Dentistry, Dr. D. Y. Patil Dental College and Hospital, Dr. D. Y. Patil Vidyapeeth, Pune, Maharashtra, India
E-mail address: sanjitsah101@gmail.com.

Aroop Mohanty
Department of Microbiology, All India Institute of Medical Sciences, Gorakhpur, Uttar Pradesh, India
E-mail address: aroopmohanty7785@yahoo.com.

Jack Feehan
School of Health and Biomedical Sciences, RMIT University, Bundoora, VIC, 3083 Australia
E-mail address: jack.feehan@rmit.edu.au.

Jaffar A. Al-Tawfiq[1]
Infectious Disease Unit, Specialty Internal Medicine, Johns Hopkins Aramco Healthcare, Dhahran, Saudi Arabia
Division of Infectious Diseases, Department of Medicine, Indiana University School of Medicine, Indianapolis, IN, USA
Division of Infectious Diseases, Department of Medicine Johns Hopkins University, Baltimore, MD, USA
E-mail addresses: jaltawfi@yahoo.com, jaffar.tawfiq@jhah.com.

Vasso Apostolopoulos[1]
School of Health and Biomedical Sciences, RMIT University, Bundoora, VIC, 3083, Australia
E-mail address: vasso.apostolopoulos@rmit.edu.au.

[*] Corresponding author.

[**] Corresponding author.
E-mail address: ranjitsah57@gmail.com (R. Sah).
E-mail address: shriyanshsrivastav@gmail.com (S. Srivastava).
Handling Editor: Patricia Schlagenhauf

[1] equally contributed.