Ebede et al. *Afr. J. Clin. Exper. Microbiol.* 2025; 26 (1): 01 - 04 https://www.afrjcem.org

African Journal of Clinical and Experimental Microbiology. ISSN 1595-689X Jan 2025; Vol.26 No.1
AJCEM/2365. https://www.ajol.info/index.php/ajcem

Mini-Review **Open Access**

Mpox: Changing epidemiology, evolving epidemic, new vaccine production, and way out in a resource-limited economy

[1,2]Ebede, S. O., *[1,2]Orabueze, I. N., [1,2]Nwafia, I. N., and [1,2]Ohanu, M. E.

[1]Department of Medical Microbiology, Faculty of Basic Clinical Sciences, College of Medicine, University of Nigeria, Ituku-Ozalla Campus, Enugu, Nigeria
[2]Department of Microbiology, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria
*Correspondence to: Iborabueze@gmail.com; +2347038908201; ORCID ID 0009-0005-8369-15

Abstract:

Mpox was declared public health emergency of continental security and public health emergency of international concern by the Africa CDC and the WHO in 2024 due to devastating global outbreak caused by newly emerged Mpox virus clades. The divergent virulent new clades are genetically and phylogenetically different from the previous ones that were endemic in Democratic Republic of the Congo, spreading to neighboring countries and other parts of the globe, with considerable morbidity and mortality. The emerged new circulating clades responsible for current epidemics are associated with changing epidemiology and new disease outcomes. Sexual transmission plays a key role in sustaining transmission, spread beyond Africa and affected mainly the sexually active young adults. To curb the menace of these epidemics, there is need to develop a polyvalent vaccine incorporating the various circulating clades. Mass vaccination with the proposed vaccine will achieve herd immunity in addition to effective infection prevention and control strategies.

Key words: Mpox, epidemiology, evolving, pandemic, vaccine, review

Received Oct 11, 2024; Revised Nov 29, 2024; Accepted Dec 1, 2024

Mpox: Evolution de l'épidémiologie, évolution de l'épidémie, nouvelle production de vaccins et solution dans une économie aux ressources limitées

[1,2]Ebede, S. O., *[1,2]Orabueze, I. N., [1,2]Nwafia, I. N., et [1,2]Ohanu, M. E.

[1]Département de Microbiologie Médicale, Faculté des Sciences Cliniques Fondamentales, Collège de Médecine, Université du Nigéria, Campus Ituku-Ozalla, Enugu, Nigéria
[2]Département de Microbiologie, Hôpital Universitaire du Nigéria, Ituku-Ozalla, Enugu, Nigéria
*Correspondance à: Iborabueze@gmail.com; +2347038908201; ORCID ID: 0009-0005-8369-15

Résumé:

Le Mpox a été déclaré urgence de santé publique de sécurité continentale et urgence de santé publique de portée internationale par le CDC Afrique et l'OMS en 2024 en raison d'une épidémie mondiale dévastatrice causée par de nouveaux clades de virus Mpox. Les nouveaux clades virulents divergents sont génétiquement et phylogénétiquement différents des précédents qui étaient endémiques en République démocratique du Congo, se propageant aux pays voisins et à d'autres parties du globe, avec une morbidité et une mortalité considérables. Les nouveaux clades circulants émergés responsables des épidémies actuelles sont associés à une épidémiologie changeante et à de nouveaux résultats de maladies. La transmission sexuelle joue un rôle clé dans le maintien de la transmission, s'est propagée au-delà de l'Afrique et a touché principalement les jeunes adultes sexuellement actifs. Pour enrayer la menace de ces épidémies, il est nécessaire de développer un vaccin polyvalent intégrant les différents clades en circulation. La vaccination de masse avec le vaccin proposé permettra d'obtenir une immunité collective en plus de stratégies efficaces de prévention et de contrôle des infections.

Mots clés: Mpox, épidémiologie, évolution, pandémie, vaccin, revue

Introduction/epidemiology of Mpox:

Mpox, formerly called Monkeypox, was declared a public health emergency of continental security by the Africa Centers for Disease Control and Prevention (Africa CDC) on 13th August 2024 due to spread to neighbouring non-endemic African countries from the deadly new strains emanating from the previously circulating clades in the Democratic Republic of the Congo (DRC) (1). In view of the uncontrollable upsurge of the mutant virulent circulating new clades of Mpox virus (MPXV) in the DRC, rapidly involving a growing number of countries in Africa, and further extending to other parts of the world, the World Health Organization (WHO) declared the current global outbreak of Mpox a public health emergency of international concern (PHEIC) on August 14, 2024 (2,3) under the 2005 International Health Regulations (IHR). So far, cases have been reported in more than 120 countries around the world with over 100,000 confirmed cases and more than 200 deaths among the confirmed cases between January 2022 and August 2024 (3).

The WHO had previously made such declaration of international concern in the year 2022. Until 2022, the scourge of Mpox in Africa has been neglected (4,5). The WHO has indicated that the previous PHEIC declaration was yet to be over (2) in view of an estimated new 15,000 Mpox cases with 461 deaths in the continent, a 160% increase when compared with the 2023 figure, while deaths have increased to a whopping 19% (6). This is a resurgence and re-emerging public health challenge jeopardzing global health security (6-8).

Mpox was first discovered in Denmark among monkeys for research in 1958 and the first human case reported in a 9-month-old boy in the DRC by the year 1970 (5-9). Mpox was previously considered a strictly zoonotic viral infection caused by MPXV (5), an enveloped double stranded DNA virus of the *Poxviridiae* family and *Orthopoxvirus* genus, existing as 2 distinct genetic clades; clade I and II (10).

Mpox generally remains asymptomatic, but the symptomatic cases may be associated with flu-like symptoms and pus-filled skin rashes in addition to fever, sore throat, headache, myalgia, and lymphadenopathy. Mpox virus is generally transmitted through close physical contact (10). However, increasing evidence from studies suggests that the sexual route of transmission is now sustaining the waves of global spread (5,8). The clade I, most commonly seen the central African countries especially in the DRC, primarily infect children and adolescents and tends to be more severe than clade II (5,8,9).

Clade II was largely confined to West Africa and until the 2022 global epidemic, was associated with mild illness and lower mortality (11). In addition, its sublinage, Clade IIa caused the 2003 Mpox human outbreak in the United States of America (12). Cameroon remains the only country known to harbor both clades (11). Clade IIb was responsible for the 2017-2019 Mpox outbreak in Nigeria and the 2022-2023 global outbreaks (9,10). These epidemics did not receive the required attention despite repeated alarms raised (1,4,5,8).

The series of human Mpox cases following zoonotic spill over with human-to-human transmission, have been reported in the DRC, Rwanda, Burundi, Nigeria and the surrounding countries. The WHO has declared the existence of several outbreaks of different clades in different countries with different modes of transmission and levels of risk. The virus remains in circulation in these endemic areas with waves of epidemics and increasing spread outside the DRC, other African countries not previously involved, and across the globe through sexual contact (5,8,10). This new trend demonstrates the sex transmissible nature of the MPXV.

However, the current 2024 epidemic is caused by a genetically modified new clades Ia, Ib and IIb described as the most virulent so far (13), due to its pathogenicity and new epidemiological characteristics. These clades have been responsible for the series of outbreaks in Africa and other parts of the world since July 2024 (11,13) and transmitted between people, especially adults, through sexual contact (10,13,14), in association with risky sexual behaviors such as non-use of condom, multiple sex partners, and men having sex with men (5,14). Physical contact with infected persons is also a risk factor. The outbreaks caused by clade Ib in the DRC primarily affects young adults mostly 20-45 years of age and is rapidly spreading in the country (5).

To curb the scourge of this epidemic, there is need for mass vaccination to achieve herd immunity. The African continent needs more than 10 million vaccine doses but only about 200,000 are currently available due to several challenges (1). These challenges include unpredictable financial resources, limited Mpox vaccine available globally, limited production of the vaccine, logistics on orders placed to the manufacturers and legal agreement delays in relation to donation of Mpox vaccines, as opposed to direct procurement. In addition, the antiviral agent, tecovirimat, for Mpox treatment is largely inadequate and expensive (1).

Discussion:

The current emerging and re-emerging dangerous new clades of MPXV circulating in the endemic areas of DRC, parts of Africa and the globe with these areas serving as the

pool for sustained transmission, necessitates the need for a prophylactic mass vaccination of those at risk that could confer herd immunity against the various known clades. New circulating clades are continuously emerging following mutations of the previously circulating clades in these endemic areas resulting in sub-linages with entirely new genome, and epidemiological characteristics especially from the DRC. Series of genomic studies (14,15) on MPXV identified unique mutational profiles, novel clades with sub-lineages, changed phylogeny, changed transmission patterns with sustainability, extended age range for individuals susceptible to the infection not previously observed.

The novel clade 1 Kamituga MPXV cluster genome for instance has a unique C9L gene which encodes a Kelch-like protein that serves as an important antagonist for the host to mount an effective innate immune response (15). This development may contribute to the changing disease outcome with the new epidemiological characteristics being observed. In addition, the overwhelming impact of sexual route as the new driver of transmission of the new sub-linages of the MPXV across the globe has been documented by several African researchers within the groups at risk. The epidemiological risk factors include male gender, age 20-42 years, multiple sex partners, homosexuality (gay), bisexual, men having sex with men, people living with HIV and co-existing hepatitis B and C infections especially among drug addicts (14,15).

With the DRC, neighboring East and West African countries serving as a pool for cluster of self-sustaining emerging and re-emerging sublinages of MPXV with mutational antigenic variability, vaccination remain the choice to curb this recurrent wave of dangerous epidemics with overwhelming challenge on the continental and global health security. Vaccines have enormous protective effect on human and animal health (16). The current Mpox vaccine needs to be re-designed as a polyvalent vaccine to offer coverage to the epidemiologically important clades. Preferably, the proposed polyvalent prototype vaccine if feasible, should be incorporated into National Programme on Immunization (NPI) in endemic countries as a single or multi-pathogen vaccine. This will minimize overhead cost, injection pain and inconvenience of multiple injections (16).

In view of the scourging PHEIC with associated global public health burden, there is need for mitigating measures to be in place. These include continental involvement with commitment and policies to mobilize neighboring countries, ministries of health, agriculture, pharmaceutical, institutions, collective wills, and resources towards securing enough doses of Mpox vaccine for human and livestock (1,2). However, this is very far from realty in view of limited global availability of currently licensed/approved Mpox vaccine, and scarcity of funds to pursue this laudable project (2).

While advocating for vaccine intervention, which obviously is a medium to long term measure, and considering the alarming rate of transmission, spread, mortality, and morbidity of the new clades, there is need for endemic countries to reinforce infection prevention and control (IPC) strategies, policies and recommendations of the Africa CDC and WHO. These involve but not limited to preventive measures and capacities gained during the COVID-19 pandemic for human, livestock and pharmaceutical industries, community engagement, risk communication and surveillance (2). Unfortunately, the gains achieved during the COVID-19 pandemic have been neglected in most African countries.

Conclusion:

The proposed polyvalent vaccine model will be of much value, cost effective and offer wider coverage towards curbing the alarming PHEIC and overwhelming global health security of the current virulent circulating MPXV clades. When this vaccine is designed, adequately implemented holistically in conjunction with the IPC strategies, it will ensure achievement of herd immunity in endemic African countries and other affected areas in the globe. In addition, this will ensure wide coverage, compliance, lifelong immunity and cost reduction.

Vaccine usage should be combined with the IPC strategies gained during the COVID-19 pandemic. The strategies gained should be upheld and sustained by all partners, stakeholders, communities, ministries of health, pharmaceutical industry, agriculture, veterinary, heads of nations committed financially with appropriate policies, Africa CDC and the WHO. Hopefully, all these measures will minimize the recurring ravaging health hazard of emerging and re-emerging clades of Mpox virus.

Ethics approval:

Ethical approval to write this review was granted by the University of Nigeria Teaching Hospital Health Research Ethics committee (NHREC/05/01/2008B-FWA00002458-IRB00002323).

Contributions of authors:

SOE conceptualized the review, INN, INO, MEO and SOE wrote the original draft of the manuscript. All authors reviewed, read and approved the final version of the manuscript submitted for publication.

Source of funding:

No funding was received for the review

Conflict of interest:

Authors declare no conflict of interest.

References:

1. Africa CDC declares monkeypox a public health emergency of continental security (PHECS). https://africacdc.org/news-item/africa-cdc-declares-mpox-a-public-health-emergency-of-continental-security-mobilizing-resources-across-the-continent/#:~:text= Addis%20Ababa%2C%20Ethiopia%2C%2013%20Aug,since%20its%20inception%20in%202017
2. WHO: First meeting of the International Health Regulations (2005) Emergency Committee regarding the upsurge of Mpox 2024. https://www.who.int/news/item/19-08-2024-first-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-upsurge-of-mpox-2024 (Accessed Sept 4, 2024)
3. European Centre for Disease Control. Epidemiological update - wee 35/2024: Mpox due to monkeypox virus clade 1. https://www.ecdc.europa.eu/en/news-events/mpox-epidemiological-update-monkeypox-2-september-2024
4. Tomori, O. Neglected Mpox resurges with virulence in Africa: Will this be another neglected war ing? J Public Health Afr. 2024; 15 (1): 730. doi:10.4102/jphia.v15i1.730
5. Nachega, J. B., San-Aguda, N.A., Ogoina, D., et al. The surge of monkeypox in Africa: a call for action. Lancet Glob Health. 2024; 12 (7) E1086-E1088.doi:10.1016/S2214-109X(24)00187-6
6. Africa CDC. Mpox outbreak declared public health emergency in Africa. https://news.sky.com/story/mpox-outbreak-declared-public-health-emergency-in-africa-13196449 (Accessed Sept 4, 2024)
7. Africa CDC. Monkeypox – Technical fact sheet. https://africacdc.org/wp-content/uploads/2022/10/Monkeypox-TECHNICAL-FACTSHEET_20Oct22_CLEARED.pdf
8. Otu, A., Ebenso, B., Walley, et al. Global human monkeypox outbreak: atypical presentation demanding urgent public health action. Lancet Microbe. 2022: 3 (22); 00153-7. doi:10.1016/S2666-5247(22)00153-7
9. Ogoina, D., Izibewule, J.H., Ogunleye, A., et al. The 2017 human monkeypox outbreak in Nigeria-Report of outbreak experience and response in the Niger Delta University Teaching Hospital, Bayelsa State, Nigeria. PLoS ONE. 2019; 14(4): e0214229.doi:10.1371/journal.pone.0214229
10. World Health Organization. Mpox newsroom fact sheet. https://www.who.int/newsroom/factsheets/detail/mpox#:~:text=Key%20facts,with%20subclades%20IIa%20and%20IIb).
11. Africa CDC: Monkeypox - Technical fact sheet. https:africacdc.org
12. CDC. Update: multistate outbreak of monkeypox-Illinois, Indiana, Kansas, Missouri, Ohio and Wisconsin. MMWR 2003;52: 537-540. https://www.cdc.gov
13. WHO: 2022-2024 Mpox (Monkeypox) outbreak: global trends. World Health Organization, 4th October 2024. https://worldhealthorg.shinyapps.io
14. Ogoina, D., Dalhat, M.M., Denue, B.A., et al. Mpox epidemiology and risk factors, Nigeria, 2022. Emerg Infect Dis. 2024; 30 (9): 1799-1808. doi:10.3201/eid3009.240135
15. Masirika, L.M., Udahemuka, J. C., Schuele, L., et al. Mapping and sequencing of cases from ongoing outbreak of clade Ib monkeypox virus in South Kivu, Eastern Democratic Republic of the Congo between September 2023 to June 2024. MedRxiv GREATLIFE Mpox consortium. doi:10.2807/1560-7917.ES.2024.29.11.2400106
16. Ohanu, M., Ezenwugo, U.C., Nwafia, N., et al. Multi-Pathogen Innovative (5 in 1) Vaccine for Viral Haemorrhagic Fevers will Save More Lives. West Afr J Med. 2023; 40 (1):121-124.