

Mpox in Africa (2022-2024)

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Background

In December 2022, the Democratic Republic of Congo (DRC) declared a national outbreak of mpox as cases increased and spread at rapid rates¹. While the DRC is the most affected country in Africa, 18 other African countries across all five regions of the continent have reported cases in 2024, including previously non-endemic countries². Overall, mpox cases in Africa have increased by more than 500% in 2024 compared to 2023 and by 79% in 2023 compared to 2022^{3,4}. Mpox is a zoonotic infectious disease caused by the monkeypox virus (MPXV)⁵. It is closely related to smallpox caused by the variola virus which is part of the same genus as MPXV; the *Orthopoxvirus* genus⁶. Mpox was first discovered in the DRC (formerly Zaire) in 1970 around the same time the last smallpox case was reported^{7,8}. Shortly after, several other West and Central African countries began reporting mpox cases with repeated zoonotic spillovers and limited human-to-human transmission⁸. Before 2022, mpox was endemic to 11 West and Central African countries affected by two distinct clades of the MPXV: clade I (formerly the Central African clade) and clade II (formerly the West African clade) which can be further subcategorised into clade IIa and clade IIb⁹. Clade I MPXV is suggested to be more deadly with a case-fatality ratio (CFR) of 10.6% compared to a CFR of 3.6% for clade II¹⁰.

Transmission, Clinical Presentation, Diagnosis, and Treatment

Mpox spreads from infected animals to humans or from infected humans to humans through direct contact with skin, bodily fluids, or contaminated objects^{5,11}. Although it is less common, infected pregnant individuals can also transmit the virus to their foetus or newborn¹¹. The incubation period ranges from approximately 1 to 21 days but on average, symptoms present within a week^{5,12}. Individuals suffering from mpox typically develop fever, lymphadenopathy, malaise, muscle aches, and a rash^{5,12,13}. The rash begins as an ulcer which becomes fluid-filled, itchy, and painful, before crusting and falling off as it heals⁵. In most cases, mpox is a self-limiting disease however, in people with a weakened immune system the disease can be fatal and complications such as bacterial skin infections, encephalitis, myocarditis, and eye problems can develop^{5,13}.

The preferred laboratory test for confirming mpox is a polymerase chain reaction (PCR) test to detect viral DNA⁵. Swabs tested are taken directly from the rash⁵. Blood samples are not recommended, and antibody testing cannot distinguish between orthopoxviruses⁵. Laboratory confirmation is necessary as mpox is difficult to distinguish from similar diseases such as measles or herpes⁵. Antivirals such as tecovirimat have been used to treat mpox however, recent preliminary evidence demonstrates that tecovirimat is ineffective at treating clade I MPXV, and further research is needed to understand its effectiveness^{5,14–16}. Bavarian Nordics Modified Vaccinia Ankara vaccine (MVA-BN) known as JYNNEOS in the United States (US) or Imvamune and Imvanex outside the US is a licensed mpox vaccine that is safe and effective however, further research is needed to understand the vaccine's effectiveness in different at-risk groups^{14,17–19}. These vaccines have been recommended for use by the World Health Organization (WHO) Strategic Advisory Group of Experts on Immunization and from 7 August 2024, Emergency Use Listing of the vaccines enabled GAVI and UNICEF to procure them for distribution without national regulatory approval^{20–22}. The MVA-BN vaccine is the first mpox vaccine to be prequalified by the WHO²³. Recent findings from a clinical trial based in the United States demonstrate that the MVA-BN vaccine is safe in adolescents aged 12 to 17 years old²⁴. These results provide encouraging evidence supporting the extended use of the vaccine to younger individuals²⁴. However, there is a need to continue evaluating the vaccine in even younger age groups²⁴. The Japanese-manufactured LC16m8 vaccine has been recommended for use in children over the age of one, and was added to the WHO Emergency Use Listing (EUL) in November 2024²⁵.

Global 2022 mpox outbreak

In May 2022, the United Kingdom (UK) reported a mpox case in an individual who had recently travelled to mpox-endemic Nigeria²⁶. Shortly after, several community-acquired cases with no links to endemic countries were reported²⁶. By July 2022, the WHO declared a Public Health Emergency of International Concern (PHEIC) as mpox spread globally²⁷. The US became the most affected country, with 32,820 cases reported between January 2022 and April 2024²⁸. The global mpox outbreak was driven by clade IIb MPXV and differed in transmission and clinical presentation from what was traditionally known^{5,29}. It spread predominantly via sexual contact and heavily affected men who have sex with men²⁹. Some cases would present with only a few genital lesions before prodromal symptoms such as fever or malaise²⁹. Mpox cases globally began to decline and the PHEIC was no longer in place by May 2023²⁷. In August 2024, a PHEIC for mpox was declared again due to the rapid rise of cases in Africa^{30,31}.

Mpox in the DRC

Mpox cases in the DRC have increased at an exponential rate since December 2022. From 1 January to 15 December 2024, there were 43,862 cases (9,513 confirmed) and 1,138 deaths (43 confirmed)². Many suspected mpox cases remain unconfirmed due to limited diagnostic capacity, and it is estimated that only 40% of suspected cases are tested with almost half testing positive^{2,32}.

Individuals less than 15 years old remain the most impacted and represent 66% of total mpox cases and 82% of deaths³³. Children may be more affected due to their reduced immunity exacerbated by high malnutrition rates and a lack of protection that previously administered smallpox vaccines would have provided to older populations^{34,35}. In addition, an increasing number of children in the DRC are presenting with mpox-measles co-infection particularly in South Kivu, Eastern DRC heightening the risk of co-infection in treatment centres where measles vaccination rates are low³⁶.

The DRC is affected by the clade I MPXV strain, which has suggested increased lethality¹. Traditionally, transmission mainly occurred via zoonotic spillover events and household contacts in provinces close to tropical rainforests⁸. However, this outbreak has seen sustained human-to-human transmission of clade I MPXV and geographical spread to urban provinces including the densely populated capital city, Kinshasa³⁷. Previously, 11 out of 26 provinces in the DRC were affected by mpox but by 25 August 2024, this increased

to all 26 provinces³³. Concerningly, mpox has spread to highly mobile populations, including displaced people, in Eastern DRC which suffers from ongoing conflict and insecurity^{1,38,39}. This region, particularly North and South Kivu, is most affected by the outbreak⁴⁰. In North Kivu, approximately a third of the people affected are internally displaced people (IDP)³². Half of the cases within this province are children and this increases to 75% within IDP camps³². As of 24 November 2024, South Kivu, which has reported a dramatically increasing trend of mpox cases, continues to have the highest number of cases in the DRC^{2,41}.

In August 2024, mpox crossed beyond DRC borders to neighbouring, previously non-endemic, East African countries (**Figure 1**)^{42–46}.

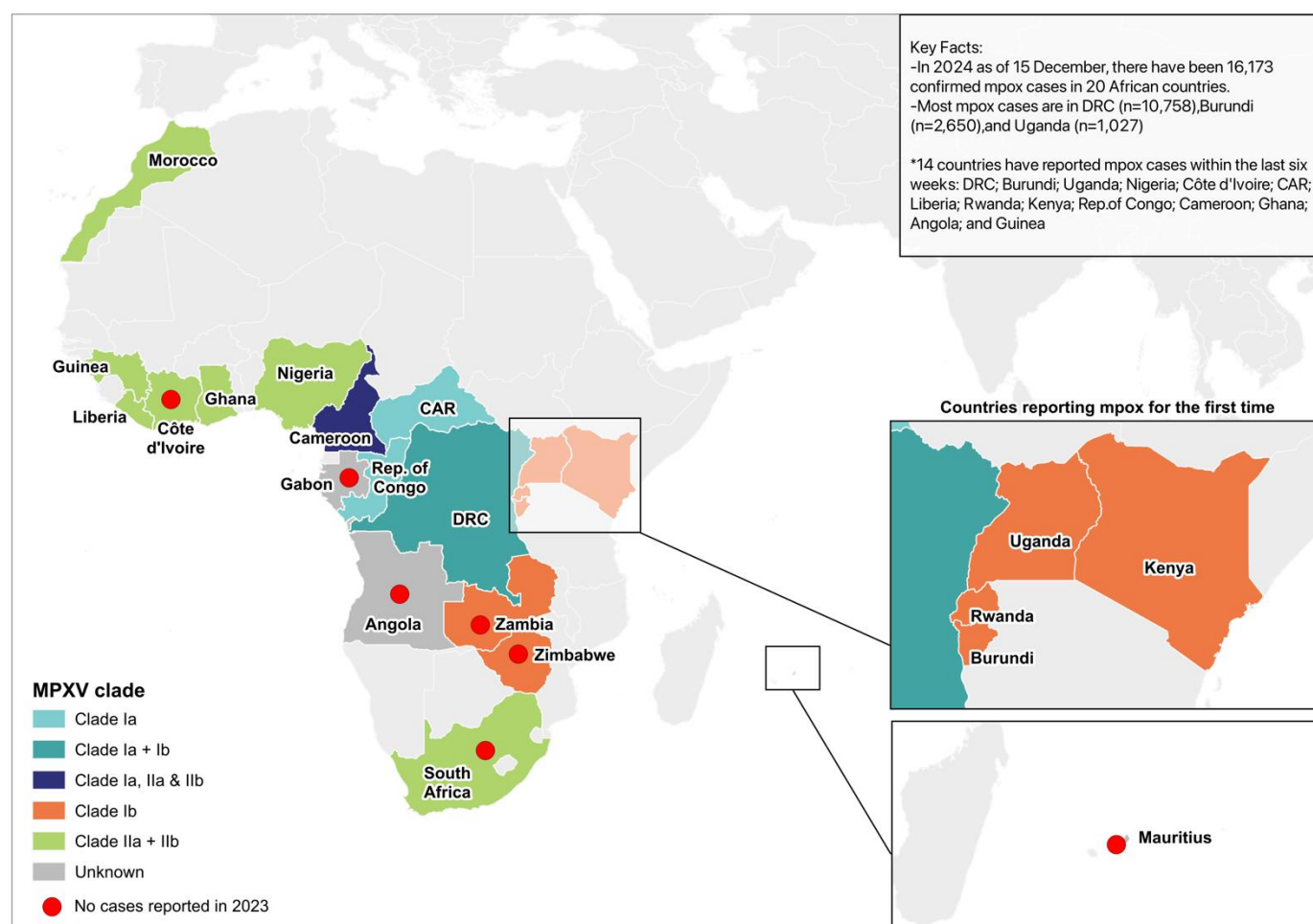


Figure 1: Mpox cases in Africa (2024)

Abbreviations: CAR (Central African Republic); Rep. of Congo (Republic of Congo); DRC (Democratic Republic of Congo)

Map made in QGIS using Natural Earth Data. Data on mpox cases was obtained from the WHO [2022-24 Mpox Outbreak: Global Trends](#) (5 Nov 2024)².

In April 2023, sexual transmission of clade I MPXV was reported for the first time from the Kwango province in DRC³⁷. The case (case 1) was a Belgian male resident who frequently travels to the DRC³⁷. After arriving in the DRC in March 2023, the individual had several sexual encounters (six men and three women)^{37,47}. Five sexual and non-sexual contacts of case 1 tested positive for mpox. Epidemiological investigations reveal that the exposure to MPXV likely occurred in Belgium, and genomic sequencing confirms that the cluster of sexually transmitted cases from Kwango is being driven by clade I MPXV³⁷. Belgium has not identified the circulation of clade I MPXV yet⁴⁸. Between September 2023 and February 2024, South Kivu province in DRC reported clade I MPXV cases driven by sexual transmission, and female professional sex workers were especially affected, comprising 29% of cases⁴⁹. Concerningly, mpox has spread to displaced people in Goma, one of the most affected regions in the North Kivu province, where

rates of sexual violence are high, increasing the likelihood of spread to victims of sexual violence^{32,50}. Transmission in North Kivu is exclusively human-to-human, with a significant portion reporting sexual transmission, particularly among professional female sex workers³².

Genomic sequencing from South Kivu samples obtained between October 2023 and January 2024 revealed a novel variant of clade I MPXV had emerged with APOBEC3-type mutations^{1,51}. This is now referred to as clade Ib. Mutations represent the deletion of a gene in the same position as the clade IIb MPXV and have led to the failure of the clade I specific RT-PCR diagnostic tests recommended by the CDC⁵². However, a new RT-PCR test specific to clade Ib MPXV detection has recently been developed to mitigate this⁵³. The novel variant is indicative of virus adaptation from sustained human-to-human transmission and recent evidence suggests that this variant is mutating at a higher rate compared to clade IIb MPXV^{49,54}. Further research is needed to determine if this novel variant is more transmissible or deadly¹. As of 13 October, clade Ib MPXV has been detected in South Kivu, North Kivu, Kinshasa, Kasai, Tshopo, and Tanganyika DRC provinces⁴¹. The CFR differs between affected DRC provinces⁴¹. Provinces affected by clade Ia MPXV have a CFR of more than 4%, whereas provinces where clade Ib MPXV is circulating have a CFR of <0.5%⁴¹. Further research is needed to determine if this difference is due to the viral, population differences, or differences in case detection and reporting⁴¹.

Mpox in Africa

Beyond the DRC, the spread of mpox in Africa is alarming. South Africa, Guinea, and Côte d'Ivoire reported clade II MPXV cases in 2024 after not reporting any cases in 2023⁵⁵. This is in addition to Nigeria, Ghana, Liberia, Morocco, and Cameroon, which continue to report clade II MPXV cases in 2024 (**Figure 1**)^{2,22,56–58}. This highlights the ongoing transmission of clade II MPXV and the continued threat it poses. Gabon has also reported mpox cases in 2024 after not reporting any in 2023, alongside Mauritius and Angola which have confirmed mpox cases in individuals with recent travel history to endemic regions. The MPXV clade responsible in these countries is yet to be determined². Along with DRC, the Central African Republic (CAR) and the Republic of Congo have continued to report cases of clade Ia in 2024²². In the Republic of Congo, cases have spread to Paoua, a region bordering Chad, increasing the risk of further spread to other countries⁴.

Even more concerning is the spread of clade I MPXV beyond the DRC to previously non-endemic countries. Initially, four East African countries, Rwanda, Burundi, Uganda, and Kenya reported mpox for the first time^{56,58}. Burundi is currently reporting the second largest number of mpox cases in Africa after the DRC^{2,46}. Cases initially identified in Rwanda and Uganda had a history of travel to the DRC^{56,58}. The mpox outbreak in Uganda has been expanding and predominantly affects sex workers however, household contacts, including children, are increasingly affected⁴¹. Uganda now reports the third largest mpox outbreak in Africa². This shift in transmission dynamics has been reported from Eastern DRC and Burundi⁴¹. The initial case identified in Kenya was a long-distance driver who had driven from Kampala in Uganda to the Taita-Taveta County in Kenya at the Tanzanian border⁵⁶. He intended to travel through Tanzania to Rwanda, demonstrating the impact that highly mobile populations have on the spread of disease beyond country borders⁵⁶. Most cases reported in Kenya as of 20 October 2024, have been persons with a history of travel including long-haul truck drivers⁴¹. By 23 October 2024, Kenya and Uganda reported their first deaths due to mpox in persons living with HIV, emphasising this population's high risk for poor mpox outcomes⁴¹. Genomic sequencing revealed that cases detected in East Africa had been infected by the novel variant (clade Ib MPXV) mainly circulating in Eastern DRC^{56,58}. In addition, Zimbabwe and Zambia have also reported cases of clade Ib MPXV for the first time after not reporting any mpox cases in 2023^{2,59}.

Central Africa remains the most impacted region and accounts for >85% of cases and >99% of deaths on the continent⁴.

Clade I MPXV outside of Africa

On 15 August 2024, mpox associated with the novel clade Ib MPXV was reported from Sweden in an individual with a recent travel history to an African country where clade Ib MPXV is circulating^{58,60,61}. This was the first reported case of clade Ib MPXV outside of Africa^{59,62}. By 16 November 2024, clade Ib MPXV cases had additionally been reported in Thailand (n=1), India (n=1), the United States (US) (n=1), and Germany (n=1)⁴¹. Similar to Sweden, cases reported in Thailand, the US, and Germany had recent travel history to an African country affected by mpox⁶⁴. However, the case reported in India had a travel history to the United Arab Emirates (UAE)^{34,65,66}.

As of 6 November 2024, the UK has reported 4 cases of clade Ib MPXV and is the first country outside of Africa to have secondary transmission of clade Ib MPXV⁶⁵. The first case identified was an individual who had a travel history to affected countries in Africa⁶⁵. The three additional cases identified are all household contacts of this case⁶⁵. Despite this new information, the European Centers for Disease Prevention and Control (ECDC) maintain that the risk of mpox to the European population remains low⁶⁵.

Public Health Response

The mpox situation in the DRC and Africa is especially concerning for the following reasons:

- Rapid human-to-human transmission is driving mpox as opposed to zoonotic spillover.
- The reports of sexual transmission associated with clade I MPXV for the first time have introduced a new mode of transmission that puts female sex workers and victims of sexual violence at increased risk.
- Children less than 15 years old are most impacted by mpox and represent the largest portion of deaths.
- A novel variant (clade Ib MPXV) has emerged and there is a lack of understanding about its transmissibility and ability to cause severe disease.
- Mpox has spread to highly mobile populations in Eastern DRC, which suffers from ongoing conflict and insecurity. This increases the risk of spread other countries. Four previously non-endemic East African countries and four non-African countries have already reported clade Ib MPXV cases (mostly imported).
- There is a lack of capacity and medical countermeasures in DRC to control the mpox outbreak and the situation is likely worse than what is being reported.
- Countries including South Africa, Côte d'Ivoire, Guinea, Zimbabwe, Zambia, and Gabon that reported no mpox cases in 2023 are reporting cases in 2024 indicating the threat of continued global mpox spread.

On 13 August 2024, Africa CDC declared a public health emergency of continental security (**Figure 2**)⁶⁶. This is the first time the declaration has been used⁶⁶. The declaration is designed to empower Africa CDC to coordinate a response and mobilise resources⁶⁶. The organisation has set up an Incident Management Team to support affected countries and while the situation is concerning, Africa CDC states that there is no need for travel restrictions at this time⁶⁶. In alignment with the Africa CDC, the WHO declared the mpox outbreak a PHEIC on 14 August 2024^{30,31}. The WHO Director-General emphasised the importance of an internationally coordinated response and UN agencies are working with the governments of affected countries^{30,31}. The WHO developed a regional response plan and anticipates that \$15 million is needed to support surveillance, preparedness, and response^{30,31}. The WHO Contingency Fund for Emergencies has released \$1.45 million so far and appeals are being made for donor support^{30,31}.

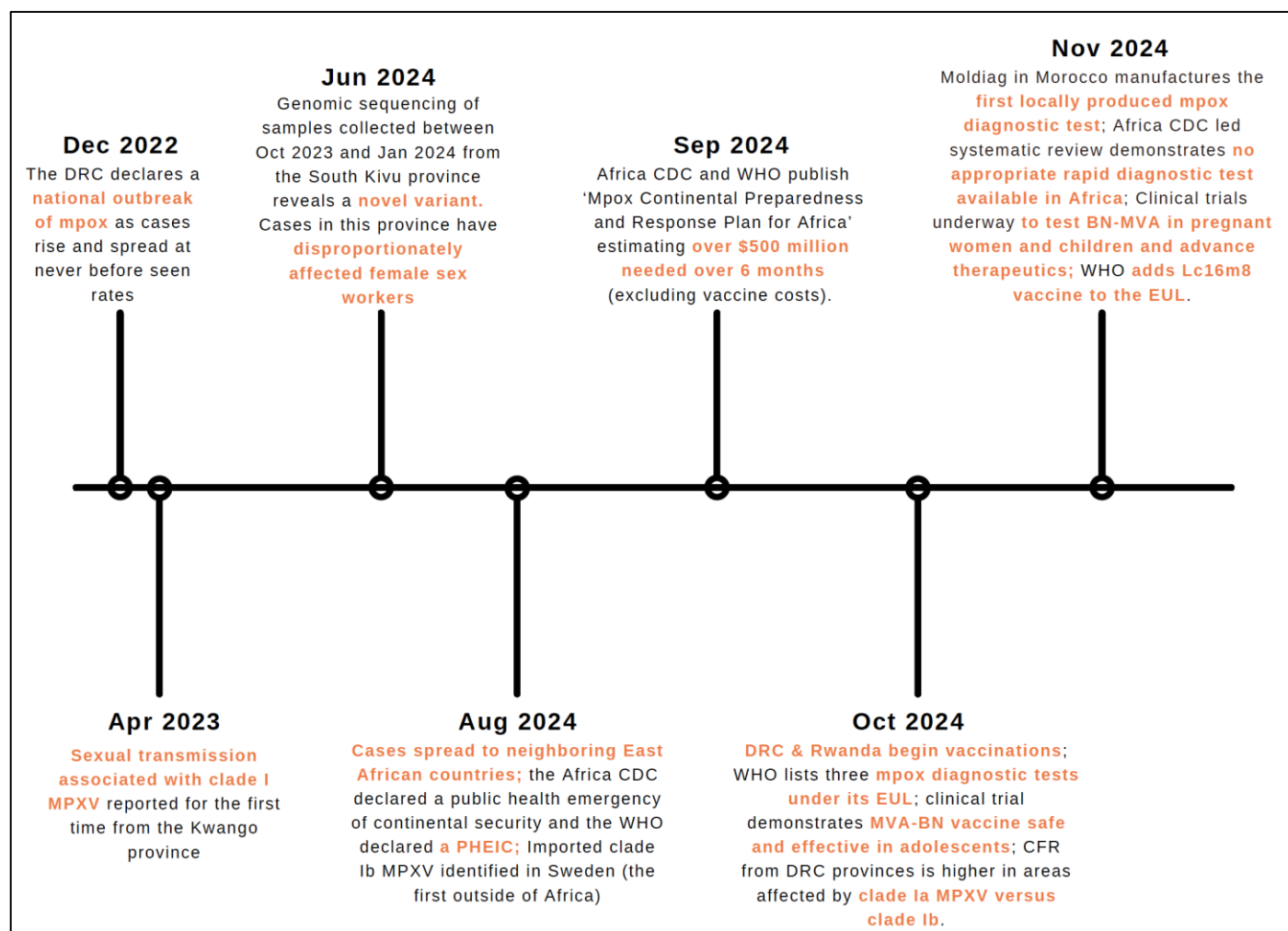


Figure 2: Summary timeline of significant events related to the DRC mpox outbreak

Africa CDC and the WHO published a Mpox Continental Preparedness and Response Plan for Africa and estimated a budget of over \$599 million needed between September 2024 and February 2025 (excluding vaccine costs)³. The preparedness and response plan outlines ten essential priorities considering cross-border transmission and highly impacted countries³. The document also developed mpox risk categories for African countries **as of 5 September 2024 (Table 1)**³.

1	Countries experiencing sustained human-to-human transmission	DRC, Burundi, Nigeria, South Africa, Cote d'Ivoire, CAR
2	Countries not in category 1 but experiencing sporadic human cases since 1 January 2022 and/or countries with zoonotic reservoirs	Rwanda, Kenya, Uganda, Sierra Leone, Liberia, Ghana, Cameroon, Gabon, Republic of Congo, Morocco, Egypt, Benin, Mozambique, Guinea, Sudan
3	Countries not in category 1 or 2 that are assessed as requiring enhanced readiness including due to proximity to category 1 countries by land, air, or sea	Angola, Zambia, Eswatini, Lesotho, Ethiopia, Somalia, South Sudan, Tanzania
4	All other countries	

Table 1: Mpox risk categorisation

As developed by Africa CDC and WHO, published in the '[Mpox Continental Preparedness and Response Plan for Africa](#)' (Sep 2024). Countries categorised are according to information available as of 5 September 2024.

As of 26 October, the WHO has assessed the mpox risk as high in DRC and moderate for all other countries⁴¹.

There is a need for strong surveillance systems to contain the outbreak. Africa CDC has published a reporting protocol for mpox surveillance for African Union Member States⁶⁷. This intends to standardise effective mpox surveillance⁶⁷. In addition, the lack of diagnostics hinders a country's ability to rapidly detect mpox cases. To boost mpox diagnostics in Africa, Moldiag in Morocco developed an RT-PCR mpox diagnostic test, which is recommended for use by the Africa CDC as of November 2024⁶⁸. This is the first locally developed mpox diagnostic test and hopes to increase diagnostic capacity by providing rapid access to these tests at an affordable cost⁶⁹. Rapid Diagnostic Tests (RDTs) to boost testing at a community level are also urgently needed⁷⁰. A systematic review by Africa CDC's Diagnostic Advisory Committee (DAC) found that there are no independently validated RDTs with a sensitivity of at least 80% suitable for use in Africa⁷⁰. The WHO Emergency Use Listing (EUL) of three diagnostic tests aims to improve global access to mpox testing (**Table 2**)^{41,71}.

WHO EUL listing date	Manufacturer	Product name
3 October	Abbott Molecular Inc.	Alinity m MPXV assay (Alinity m AMPXV Amplification (AMP) Kit & Alinity m MPXV Control (CTRL) Kit)
14 October	Roche Molecular Systems Inc.	Cobas MPXV Qualitative assay for use on the cobas 6800/8800 Systems
28 October	Cepheid	Xpert Mpox

Table 2: Diagnostics listed under WHO Emergency Use Listing⁷¹

The lack of medical countermeasures (MCMs) available is concerning. Africa CDC has called for international solidarity as it states that the continent needs 10 million vaccines⁷². Several steps have been taken to support DRC and the wider African continent in obtaining MCMs. These include:

- The WHO-initiated process for Emergency Use Listing (EUL) for mpox vaccines enabling Gavi and UNICEF to procure vaccines and increase access to countries yet to obtain national regulatory approval^{30,31}.
- The establishment of an access and allocation mechanism for mpox medical countermeasures (including vaccines) by the WHO and partners⁷³.
- The prequalification of the MVA-BN mpox vaccine by the WHO that will help accelerate the procurement of mpox vaccines²³. In addition, the inclusion of the LC16m8 mpox vaccine to the WHO EUL will facilitate access to vaccines, particularly for children²⁵.
- A UNICEF issued emergency tender that aims to secure mpox vaccines for the most impacted countries in collaboration with various partners, including Africa CDC, GAVI, WHO, and PAHO⁷⁴. One outcome of this tender has been an agreement to secure MVA-BN vaccines at the lowest market price ensuring vaccine access to 77 low- and middle-income countries⁷⁵.
- A partnership between Africa CDC and Bavarian Nordic to enhance vaccine manufacturing capacity in Africa⁷⁶.
- The MOSA clinical trial sponsored by PANTHER, which aims to advance mpox therapeutics across Africa⁷⁷.
- A clinical trial jointly funded by CEPI and Global Health EDCTP3, which will test the BN-MVA vaccine in pregnant women and children less than 2 years old⁷⁸.

As of 5 October 2024, the DRC has started vaccinating high-risk groups in Eastern DRC, the most affected region⁷⁹. They have also extended use to adolescents⁴. They obtained vaccines against mpox from Bavarian

Nordic, the United States, Gavi, and Europe including the European Commission's Health Emergency Preparedness and Response Authority (HERA)^{79,80}. While over 280,000 vaccine doses have already arrived in Africa, 5.3 million doses have been pledged so far⁸⁰. Rwanda has also started vaccinations against mpox alongside Nigeria^{4,81}.

Useful Resources

- Pandemic PACT has our dedicated [Mpox page](#) in the Outbreak section of the website which provides information and analyses of active mpox research and funding globally since 2020.
- The WHO Research & Development (R&D) Blueprint for Epidemics team has developed vaccine and therapeutic trackers for mpox which can be found in the 'Technical Areas' section of their [webpage](#) on Mpox^{82,83}.
- The WHO R&D Blueprint team has also developed '[A Coordinated Research Roadmap](#)' which suggests necessary research and a '[Mpox outbreak and study sites](#)' interactive online tracker with information on studies being conducted in the African region.
- ANRS publishes a [Weekly Scientific Review](#) on the mpox outbreak. This contains up-to-date information on relevant mpox publications and guidelines.

References

1. World Health Organization. Mpox - Democratic Republic of the Congo [Internet]. Disease Outbreak News. 2024 [cited 2024 Jul 15]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2024-DON522>
2. World Health Organization. 2022-24 Mpox (Monkeypox) Outbreak: Global Trends [Internet]. 2024 [cited 2024 Aug 28]. Available from: https://worldhealthorg.shinyapps.io/mpox_global/
3. Africa CDC, World Health Organization. Mpox Continental Preparedness and Response Plan for Africa [Internet]. 2024 [cited 2024 Sep 14]. Available from: <https://africacdc.org/download/mpox-continental-preparedness-and-response-plan-for-africa/>
4. Weekly Special Press Briefing #14. Mpox Outbreak and other Health Emergencies in Africa [Internet]. [cited 2024 Nov 8]. Available from: <https://africacdc.org/news-item/weekly-special-press-briefing-on-the-mpox-outbreak-and-other-health-emergencies-in-africa-5/>
5. World Health Organization. Mpox (monkeypox) [Internet]. Factsheets. 2023 [cited 2024 Jul 15]. Available from: <https://www.who.int/news-room/fact-sheets/detail/monkeypox>
6. Mitjà O, Ogoina D, Titanji BK, Galvan C, Muyembe JJ, Marks M, et al. Monkeypox. The Lancet. 2023 Jan;401(10370):60–74.
7. Members of the Global Commission for the certification of smallpox eradication. The Global Eradication of Smallpox. Final Report of the Global Commission for the Certification of Smallpox Eradication, Geneva, December 1979. Geneva: World Health Organization; 1980.
8. Fenner F, Wittek R, Dumbell KR. Monkeypox Virus. In: The Orthopoxviruses. San Diego: Academic Press, Inc.; 1988.
9. World Health Organization. Multi-country monkeypox outbreak in non-endemic countries [Internet]. Disease Outbreak News. 2022 [cited 2024 Jul 15]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON385>
10. Bunge EM, Hoet B, Chen L, Lienert F, Weidenthaler H, Baer LR, et al. The changing epidemiology of human monkeypox—A potential threat? A systematic review. PLoS Negl Trop Dis. 2022 Feb 1;16(2).
11. US Centers for Disease Control and Prevention. How It Spreads [Internet]. Mpox. 2024 [cited 2024 Aug 15]. Available from: <https://www.cdc.gov/poxvirus/mpox/if-sick/transmission.html>
12. US Centers for Disease Control and Prevention. Signs and Symptoms [Internet]. Mpox. 2024 [cited 2024 Aug 15]. Available from: <https://www.cdc.gov/poxvirus/mpox/symptoms/index.html>
13. Nigerian Centre for Disease Control. Monkeypox Public Health Response Guidelines. 2019.

14. European Medicines Agency. Mpox (monkeypox) [Internet]. Mpox (monkeypox). 2024 [cited 2024 Jul 15]. Available from: <https://www.ema.europa.eu/en/mpox-monkeypox>
15. Centers for Disease Control and Prevention NC for E and ZID (NCEZID) Division of High Consequence Pathogens and Pathology (DHCPP). Mpox Treatment Information for Healthcare Professionals. Centers for Disease Control. 2024.
16. National Institute of Allergy and Infectious Diseases. The Antiviral Tecovirimat is Safe but Did Not Improve Clade I Mpox Resolution in Democratic Republic of the Congo NIH-Cosponsored Study Examined Tecovirimat in Mpox-Endemic Country. News Releases [Internet]. 2024 Aug 15 [cited 2024 Aug 18]; Available from: <https://www.niaid.nih.gov/news-events/antiviral-tecovirimat-safe-did-not-improve-clade-i-mpox-resolution-democratic-republic>
17. Deputy NP, Deckert J, Chard AN, Sandberg N, Moulia DL, Barkley E, et al. Vaccine Effectiveness of JYNNEOS against Mpox Disease in the United States. N Engl J Med. 2023 Jun 29;388(26):2434–43.
18. FDA News Release. FDA approves first live, non-replicating vaccine to prevent smallpox and monkeypox [Internet]. U.S. Food & Drug Administration. 2019 [cited 2024 Jul 15]. Available from: <https://www.fda.gov/news-events/press-announcements/fda-approves-first-live-non-replicating-vaccine-prevent-smallpox-and-monkeypox>
19. US Centers for Disease Control and Prevention. Vaccination [Internet]. Mpox. 2024 [cited 2024 Aug 15]. Available from: <https://www.cdc.gov/poxvirus/mpox/interim-considerations/overview.html>
20. World Health Organization. Meeting of the Strategic Advisory Group of Experts on Immunization, March 2024: conclusions and recommendations [Internet]. 2024 May [cited 2024 Aug 19]. Available from: <https://www.who.int/publications/i/item/WER-9922-285-306>
21. WHO invites mpox vaccine manufacturers to submit dossiers for emergency evaluation. World Health Organization [Internet]. 2024 Aug 9 [cited 2024 Aug 15]; Available from: <https://www.who.int/news/item/09-08-2024-who-invites-mpox-vaccine-manufacturers-to-submit-dossiers-for-emergency-evaluations>
22. WHO Director-General's opening remarks at the media briefing – 7 August 2024 [Internet]. World Health Organization; 2024 [cited 2024 Aug 19]. Available from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing---7-august-2024>
23. World Health Organization. WHO prequalifies the first vaccine against mpox. News [Internet]. 2024 Sep 13 [cited 2024 Sep 14]; Available from: <https://www.who.int/news/item/13-09-2024-who-prequalifies-the-first-vaccine-against-mpox>
24. NIH. Mpox vaccine is safe and generates a robust antibody response in adolescents. News Releases [Internet]. 2024 [cited 2024 Oct 28]; Available from: <https://www.nih.gov/news-events/news-releases/mpox-vaccine-safe-generates-robust-antibody-response-adolescents>
25. WHO adds LC16m8 mpox vaccine to Emergency Use Listing [Internet]. [cited 2024 Nov 22]. Available from: <https://www.who.int/news/item/19-11-2024-who-adds-lc16m8-mpox-vaccine-to-emergency-use-listing>
26. World Health Organization. Monkeypox– United Kingdom of Great Britain and Northern Ireland [Internet]. Disease Outbreak News. 2022 [cited 2024 Aug 7]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON383>
27. Schnirring L. WHO declares end to mpox public health emergency. CIDRAP [Internet]. 2023 May 11 [cited 2024 Aug 7]; Available from: <https://www.cidrap.umn.edu/mpox/who-declares-end-mpox-public-health-emergency>
28. World Health Organization. Multi-country outbreak of mpox, External situation report#33- 31 May 2024 [Internet]. Geneva; 2024 May [cited 2024 Aug 7]. Available from: <https://www.who.int/publications/m/item/multi-country-outbreak-of-mpox--external-situation-report-33--31-may-2024>
29. World Health Organization. Multi-country monkeypox outbreak: situation update [Internet]. Disease Outbreak News. 2022 [cited 2022 Jun 7]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON390>
30. WHO Director-General declares mpox outbreak a public health emergency of international concern. World Health Organization [Internet]. 2024 Aug 14 [cited 2024 Aug 15]; Available from: <https://www.who.int/news/item/14-08-2024-who-director-general-declares-mpox-outbreak-a-public-health-emergency-of-international-concern#:~:text=The%20two%20vaccines%20currently%20in,including%20Nigeria%20and%20the%20DRC.>
31. WHO declares mpox virus a public health emergency of international concern. UN News Global perspective Human stories [Internet]. 2024 Aug 14 [cited 2024 Aug 15]; Available from: <https://news.un.org/en/story/2024/08/1153176>

32. World Health Organization. Mpox: Multi-country External Situation Report #39 - 6 October 2024 [Internet]. 2024 [cited 2024 Oct 11]. Available from: <https://www.who.int/publications/m/item/multi-country-outbreak-of-mpox--external-situation-report--39---6-october-2024>
33. Africa CDC Epidemic Intelligence Weekly Report, 23 August 2024 [Internet]. Africa CDC; 2024 [cited 2024 Aug 28]. Available from: <https://africacdc.org/download/africa-cdc-weekly-event-based-surveillance-report-august-2024/>
34. Akilimali A, Banga S, Oduoye MO, Biamba C, Munyangi A, Byiringiro E, et al. Malnutrition among under-five children in Democratic Republic of the Congo: A plague of the health system. *Ann Med Surg*. 2022 Oct;82.
35. Rimoin AW, Mulembakani PM, Johnston SC, Lloyd Smith JO, Kisalu NK, Kinkela TL, et al. Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo. *Proc Natl Acad Sci*. 2010 Sep 14;107(37):16262–7.
36. Mpox-measles co-infections reported in hard-hit DR Congo provinces | CIDRAP [Internet]. 2024 [cited 2024 Nov 8]. Available from: <https://www.cidrap.umn.edu/mpox/mpox-measles-co-infections-reported-hard-hit-dr-congo-provinces>
37. World Health Organization. Mpox (monkeypox) - Democratic Republic of the Congo [Internet]. *Disease Outbreak News*. 2023 [cited 2024 Jul 15]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON493>
38. Medecins Sans Frontieres. Mpox in DR Congo: Who, what, when, where, and why [Internet]. *News & Stories*. 2024 [cited 2024 Aug 6]. Available from: <https://www.doctorswithoutborders.org/latest/mpox-dr-congo-who-what-when-where-and-why>
39. Center for Preventive Action. Conflict in the Democratic Republic of Congo [Internet]. *Global Conflict Tracker*. 2024 [cited 2024 Aug 12]. Available from: <https://www.cfr.org/global-conflict-tracker/conflict/violence-democratic-republic-congo>
40. World Health Organization. Mpox Multi-country external situation report n. 37. 22 September. Geneva; 2024 Sep.
41. World Health Organization. Multi-country outbreak of mpox, External situation report #41- 26 October 2024 [Internet]. 2024 [cited 2024 Oct 28]. Available from: <https://www.who.int/publications/m/item/multi-country-outbreak-of-mpox--external-situation-report--41--26-october-2024>
42. Asadu C. Mpox outbreak declared in Kenya and Central African Republic. The race is on to contain the spread. *AP World News* [Internet]. 2024 Jul 31 [cited 2024 Aug 6]; Available from: <https://apnews.com/article/mpox-kenya-central-african-republic-outbreak-disease-7da16b2ccad88b7580318322bb0798ed>
43. Xinhua. Uganda records 2 imported mpox cases. *The East African* [Internet]. 2024 Aug 4 [cited 2024 Aug 6]; Available from: <https://www.theeastafrican.co.ke/tea/news/east-africa/uganda-records-2-imported-mpox-cases-4712440>
44. Cohen J. Deadlier strain of mpox spreads to multiple African countries. *Science Insider* [Internet]. 2024 Aug 3 [cited 2024 Aug 6]; Available from: <https://www.science.org/content/article/deadlier-strain-mpox-spreads-more-african-countries>
45. Africa Centers for Disease Control and Prevention. Mpox Situation in Africa. 2024 Jul.
46. Africa CDC. Africa CDC Epidemic Intelligence Report. Date of Issue: 6 Oct 2024. 2024.
47. Kibungu EM, Vakaniaki EH, Kinganda-Lusamaki E, Kalonji-Mukendi T, Pukuta E, Hoff NA, et al. Clade I–Associated Mpox Cases Associated with Sexual Contact, the Democratic Republic of the Congo. *Emerg Infect Dis*. 2024 Jan;30(1).
48. Liesenborghs L, Coppens J, Van Dijck C, Brosius I, De Baetselier I, Vercauteren K, et al. No Evidence for Clade I Monkeypox Virus Circulation, Belgium. *Emerg Infect Dis*. 2023 Feb;30(2).
49. Vakaniaki EH, Kacita C, Kinganda-Lusamaki E, O'Toole Á, Wawina-Bokalanga T, Mukadi-Bamuleka D, et al. Sustained human outbreak of a new MPXV clade I lineage in eastern Democratic Republic of the Congo. *Nat Med*. 2024 Jun 13;
50. Medecins Sans Frontieres. Mpox outbreak in DR Congo: What to know [Internet]. *New & Stories*. 2024 [cited 2024 Aug 18]. Available from: <https://www.doctorswithoutborders.org/latest/mpox-outbreak-dr-congo-what-know>
51. O'Toole Á, Neher RA, Ndodo N, Borges V, Gannon B, Gomes JP, et al. APOBEC3 deaminase editing in mpox virus as evidence for sustained human transmission since at least 2016. *Science*. 2023 Nov 3;382(6670):595–600.
52. Masirika LM, Udahehuka JC, Ndishimye P, Martinez GS, Kelvin P, Nadine MB, et al. Epidemiology, clinical characteristics, and transmission patterns of a novel Mpox (Monkeypox) outbreak in eastern Democratic Republic of the Congo (DRC): an observational, cross-sectional cohort study. *medRxiv*. 2024 Mar 5;

53. Schuele L, Masirika LM, Udahehuka JC, Siangoli FB, Mbiribindi JB, Ndishimye P, et al. Real-time PCR assay to detect the novel Clade Ib monkeypox virus, September 2023 to May 2024. *Eurosurveillance*. 2024 Aug 8;29(32).
54. Yeh TY, Feehley PJ, Feeley M, Chen CF, Tsai TY, Cheng HL, et al. Genomic recombination of rapidly evolving mpox Ib strains compounds the challenges of the 2024 outbreak. *medRxiv*. 2024 Sep 18;
55. Africa CDC. Africa CDC Epidemic Intelligence Report. 26 Oct 2024. 2024.
56. World Health Organization. Multi-country outbreak of mpox, External situation report#35- 12 August 2024 [Internet]. Geneva; 2024 Aug [cited 2024 Aug 18]. Available from: <https://www.who.int/publications/m/item/multi-country-outbreak-of-mpox--external-situation-report-35--12-august-2024>
57. World Health Organization. Mpox - South Africa. Disease Outbreak News [Internet]. 2024 Jul 9 [cited 2024 Aug 18]; Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2024-DON525>
58. European Centre for Disease Prevention and Control. Risk assessment for the EU/EEA of the mpox epidemic caused by monkeypox virus clade I in affected African countries – 16 August 2024. Stockholm: ECDC; 2024.
59. Africa CDC Epidemic Intelligence Weekly Report, 03 November 2024 [Internet]. [cited 2024 Nov 8]. Available from: <https://africacdc.org/download/africa-cdc-weekly-event-based-surveillance-report-november-2024/>
60. Ringstrom A, Steenhuysen J. WHO confirms first case of new mpox strain outside Africa as outbreak spreads. Reuters [Internet]. 2024 Aug 15 [cited 2024 Aug 18]; Available from: <https://www.reuters.com/world/europe/who-confirms-first-case-new-mpox-strain-outside-africa-outbreak-spreads-2024-08-15/>
61. World Health Organization. Mpox - Sweden [Internet]. Disease Outbreak News. 2024 [cited 2024 Sep 27]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2024-DON531>
62. Thailand confirms Asia's first known case of new mpox strain. *Aljazeera*. 2024 Aug 22;
63. Suri M, Iyer AS. India confirms first case of deadlier mpox strain. *CNN* [Internet]. 2024 Sep 25 [cited 2024 Sep 27]; Available from: <https://www.cnn.com/2024/09/25/asia/india-mpox-first-case-1b-hnk-intl/index.html>
64. European Centre for Disease Prevention and Control. Weekly Communicable Disease Threat Report. Week 39, 21 - 27 September 2024. Solna, Sweden: ECDC; 2024.
65. ECDC. Communicable disease threats report, 2-8 November 2024, week 45 [Internet]. 2024 [cited 2024 Nov 8]. Available from: <https://www.ecdc.europa.eu/en/publications-data/communicable-disease-threats-report-2-8-november-2024-week-45>
66. Africa CDC Declares Mpox A Public Health Emergency of Continental Security, Mobilizing Resources Across the Continent. Africa CDC [Internet]. 2024 Aug 13 [cited 2024 Aug 15]; Available from: <https://africacdc.org/news-item/africa-cdc-declares-mpox-a-public-health-emergency-of-continental-security-mobilizing-resources-across-the-continent/>
67. Africa CDC. Strengthening Africa's Fight Against Mpox: A Unified Surveillance Protocol. News/ Reviews [Internet]. 2024 Nov 29 [cited 2024 Dec 9]; Available from: <https://africacdc.org/news-item/strengthening-africas-fight-against-mpox-a-unified-surveillance-protocol/>
68. Africa CDC. Morocco's First Homegrown PCR Test for mpox Gets Africa CDC Nod. News/Press Releases [Internet]. 2024 Nov 12 [cited 2024 Dec 9]; Available from: <https://africacdc.org/news-item/moroccos-first-homegrown-pcr-test-for-mpox-gets-africa-cdc-nod/>
69. Sam Metz, Ruth Alonga. Morocco produces Africa's first mpox tests as the continent tries to rely less on imports. *AP News* [Internet]. 2024 Dec 9 [cited 2024 Dec 9]; Available from: <https://apnews.com/article/africa-mpox-morocco-tests-health-160a6ac88cf9f7f5cad729c4dea97cde>
70. Statement on Antigen Rapid Tests for Mpox Diagnosis, 30 October 2024 [Internet]. Africa CDC. [cited 2024 Nov 8]. Available from: <https://africacdc.org/download/statement-on-antigen-rapid-tests-for-mpox-diagnosis-30-october-2024/>
71. World Health Organization. WHO Emergency Use List: Monkeypox virus IVDs/ Nucleic Acid Tests. Last updated 28 October 2024. 2024.
72. Africa CDC. With just 200,000 Mpox vaccine doses available out of the 10 million needed to control the outbreak, global solidarity is essential. Let's unite in supporting vaccination efforts worldwide. #VaccinesSaveLives [Internet]. X (formerly Twitter). 2024 [cited 2024 Aug 18]. Available from: <https://x.com/AfricaCDC/status/1822210795054260327>

73. World Health Organization. WHO and partners establish an access and allocation mechanism for mpox vaccines, treatments, tests. News [Internet]. 2024 Sep 13 [cited 2024 Sep 14]; Available from: <https://www.who.int/news/item/13-09-2024-who-and-partners-establish-an-access-and-allocation-mechanism-for-mpox-vaccines--treatments--tests>
74. World Health Organization. UNICEF issues emergency tender to secure mpox vaccines for crisis-hit countries in collaboration with Africa CDC, Gavi and WHO. News [Internet]. 2024 Aug 31 [cited 2024 Sep 14]; Available from: <https://www.who.int/news/item/31-08-2024-unicef-issues-emergency-tender-to-secure-mpox-vaccines-for-crisis-hit-countries-in-collaboration-with-africa-cdc--gavi-and-who>
75. UNICEF. UNICEF signs mpox vaccine deal at lowest market price for 77 low- and lower-middle-income countries. News Note [Internet]. 2024 Sep 26 [cited 2024 Sep 27]; Available from: <https://www.unicef.org/supply/press-releases/unicef-signs-mpox-vaccine-deal-lowest-market-price-77-low-and-lower-middle-income>
76. Africa CDC. Africa CDC and Bavarian Nordic Partner to Boost Mpox Vaccine Production in Africa. News/Statement [Internet]. 2024 [cited 2024 Oct 11]; Available from: <https://africacdc.org/news-item/africa-cdc-and-bavarian-nordic-partner-to-boost-mpox-vaccine-production-in-africa/>
77. Driving Pan-African Research Collaboration: PANTHER and Africa CDC Launch the Mpox Study in Africa. Africa CDC [Internet]. [cited 2024 Nov 8]; Available from: <https://africacdc.org/news-item/driving-pan-african-research-collaboration-panther-and-africa-cdc-launch-the-mpox-study-in-africa/>
78. New study to assess mpox vaccine in pregnant women and infants | CEPI. CEPI [Internet]. [cited 2024 Nov 8]; Available from: <https://cepi.net/new-study-assess-mpox-vaccine-pregnant-women-and-infants>
79. WHO DRC. The Democratic Republic of the Congo kicks off mpox vaccination. News [Internet]. 2024 [cited 2024 Oct 11]; Available from: <https://www.afro.who.int/countries/democratic-republic-of-congo/news/democratic-republic-congo-kicks-mpox-vaccination>
80. Searchinger C, Krugman A. Mpox Vaccine Tracker: Millions Pledged, Millions Still to Be Delivered. Think Global Health [Internet]. 2024 Oct 8 [cited 2024 Oct 11]; Available from: https://www.thinkglobalhealth.org/article/mpox-vaccine-tracker-millions-pledged-millions-still-be-delivered?utm_medium=social_owned&utm_source=tw_tgh
81. Africa CDC. Mpox Vaccination Programme Gets off the Ground in Nigeria. News/Stories [Internet]. 2024 Dec 11 [cited 2024 Dec 20]; Available from: <https://africacdc.org/news-item/mpox-vaccination-programme-gets-off-the-ground-in-nigeria/>
82. WHO R&D Blue Print Team. Landscape of Therapeutics licensed or under development for Mpox [Internet]. 2024 [cited 2024 Aug 18]. Available from: <https://www.who.int/publications/m/item/landscape-of-therapeutics-licensed-or-under-development-for-mpox>
83. WHO R&D Blueprint Team. Landscape of vaccines licensed or under development for Mpox [Internet]. [cited 2024 Aug 18]. Available from: <https://www.who.int/publications/m/item/landscape-of-vaccines-licensed-or-under-development-for-mpox>