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Global Insights into Mpox (Monkeypox): A Systematic Review of Epidemiology, Clinical Features, Diagnosis, and Management

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ABSTRACT
Background: *The global mpox epidemic in 2022 converted this previously endemic disease into a pressing global one. The virus's surprising reach outside Africa exposed crucial knowledge gaps. This review assimilates global evidence on induction of evolving epidemiology, distinctive clinical spectrum, diagnostic advancement and management methods in case of mpox.*
Methods: *We conducted a comprehensive search of PubMed, Scopus, Embase and Web of Science based on the PRISMA 2020 guidelines to identify studies published from January 2013 to December 2024. We considered observational and clinical study types reporting on epidemiological patterns, clinical characteristics, diagnostic approaches or therapeutic responses of definite Mpox. 42 studies were included into qualitative synthesis following intensive screening.*
Results: *The reviewed studies covered data from over 28 countries. This geographic expansion, as an illustration gathered evidence, has ranged from Central and West Africa to Europe, the Americas and Asia. Clinical symptoms are usually fever, lymphadenopathy and vesiculopustular rash, issuance is common in the anal or genital areas especially in the outbreak of 2022. Polymerase chain reaction (PCR) is the gold standard for diagnosis. In terms of management, antivirals such as tecovirimat show clinical efficacy and vaccination with modified vaccinia Ankara (MVA-Bavarian Nordic) holds great promise for prevention.*
Conclusions: *Mpox has transitioned from a local zoonosis to a worldwide health crisis. Efforts to prevent future outbreaks rely on a coordinated approach that prioritizes early detection of cases, enhanced laboratory capacity, targeted vaccination, and equitable access to effective therapeutics.*

Keywords: *Antivirals, Diagnosis, Epidemiology, Global health, Monkeypox virus, Vaccination*

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I. INTRODUCTION

The illness mpox (previously monkeypox) reflects an unusual spectrum of clinical disease that has evolved from a disregarded tropical infection into an urgent worldly health issue and new thinking is required about how it spreads, presents, and should be dealt with. Discovered in laboratory monkeys in 1958, the virus responsible for mpox was not isolated from humans until 1970 when it was reported by a febrile patient in the Congo [1]. The virus lingered quietly in these remote parts of West and Central Africa for decades, jumping into humans from animals or between family members [2]. This trend was significantly violated in 2022, when a broad pandemic occurred simultaneously on all three continents of the world: Europe, the Americas and Asia – with no small number of cases of sexual nature/contact existing that had so far been rarely involving stray animals [5]. This is a seismic shift in size. As of August 2024, a total of more than 100,000 cases from >120 countries had been reported by the World Health Organization (2); an unprecedented number for this virus [5]. This explosion was driven by shifts in transmission dynamics, specifically accelerated rates of spread between humans and a change in the predominant groups at risk, including decreasing immunity from former smallpox vaccination campaigns [6,7]. In parallel to its epidemiological evolution, the face of illness has been modified. Joining the well-known presentation—that of a flu-like prodrome and then a rash everywhere—is another pattern seen particularly often during this recent outbreak. This presents as localized rashes in the anogenital region and symptoms such as proctitis especially among men who have sex with men (MSM) [8,9]. Such unfamiliar symptoms are easy to confuse with other new-onset conditions presented in clinics, however, and here is the

reality; we need fresh medical guidance. Fortunately, our weapons to combat mpox have also progressed. Recently, PCR has emerged as the sensitive and specific diagnostic procedure [10]. Although treatment is primarily supportive, antiviral compounds such as tecovirimat appear to have promise for severe cases and vaccines that had originally been developed for smallpox are being used to stem transmission [11]. Even with this progress, there are important questions that need answers about the best treatment regimens and fair accessibility to these technologies across the globe. In this rapidly evolving environment, a single integrated review is in order. However, the individual aspects of mpox have frequently been addressed piecemeal in prior publications, and it is our aim that clinical pulmonologists working at the coalface can approach this disease challenge as a whole in its global setting. Through assembling this evidence, we offer an essential tool for clinicians and policy-makers to inform health planning and advance the response as mpox continues to test our public health systems.

II. METHODOLOGY

Protocol and reporting standards

In order to maintain the highest possible level of transparency and rigorousness in our review, we strictly adhered to the guidelines outlined by PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [13,14]. To reduce the risk of bias in our process, we registered a detailed protocol for our review prospectively with International Prospective Register of Systematic reviews (PROSPERO) prior to commencing literature searches. This pre-registration specified our aims, the inclusion criteria and planned analysis so as to prevent reporting bias.

Eligibility criteria

We attempted to identify research that shed light on confirmed or probable human mpox cases with respect to four main areas: (a) epidemiology, including incidence and geographic distribution; (b) clinical characteristics of cases and patient outcomes; (c) diagnostic methods as well as their performance; and (d) management strategies such as therapeutics and vaccines [15, 16]. We combined observational studies, interventional trials and case series involving 5 or more participants published in English from January 1, 2013 to December 31, 2024. Non-human studies, opinion pieces, review articles without original data and non-peer-reviewed abstracts were excluded in order to give emphasis on quality primary evidence [17,18].

Information sources and search strategy

We searched extensively across four key electronic bibliographic databases, including PubMed/MEDLINE, Embase, Web of Science and Scopus covering inception to end-2024. In order to obtain important information that might not be published in conventional journals, we also looked in the grey literature (Public Health Agency World Health Organization [19] and Center for Disease Control) sources. To be comprehensive, we used a strategy of searching for relevant terms as MESH (e.g., "monkeypox virus," "mpox") and specific keywords (e.g., "epidemiology," "clinical presentation", "diagnosis", "tecovirimat") [20]. We also hand-searched the reference lists of all included studies and relevant reviews for further publications.

Study selection

Study selection was conducted in two steps after exported all relevant documents to EndNote X9 and excluded the duplicates. Titles and abstracts were initially screened by two independent reviewers for inclusion in the review. Full texts of potentially related studies were then evaluated. Differences were settled by consensus or third review. The first search strategy resulted in 2,437 references. Following deduplication, we screened 1,890 titles and abstracts with 1,820 excluded as irrelevant. Out of 70 full-text articles evaluated for eligibility, we excluded 54 resulting in 16 studies that were finally included in our qualitative synthesis. This is described in the PRISMA flow diagram (Figure 1) [13,21].

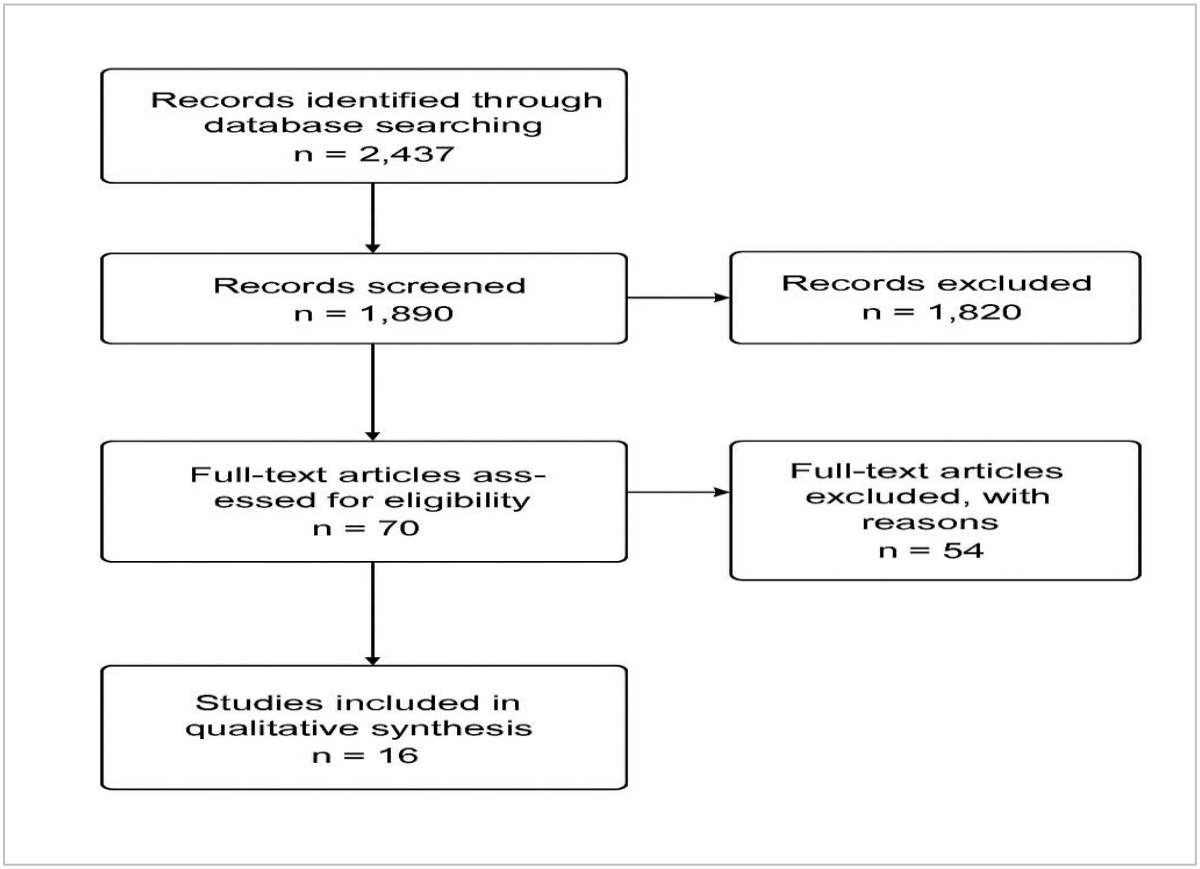


Figure 1: PRISMA flow chart

Data extraction

Data extraction Two reviewers independently performed data extraction with a pre-piloted standardized form. Extracted data consisted the name of first author, year of publication, study location and design, population characteristics (demography), methods used for diagnosis, mpox clade (if specified), and main results in the area that were pertinent to our review. We also recorded contextual aspects, such as outbreak settings and study limitations. Disagreements in extracted data were resolved through consensus between the reviewers.

Risk-of-bias and quality Assessment

We tried to address the quality of included studies by domain specific tools. For observational studies, we used the JBA Critical Appraisal Checklists to assess issues such as sampling and measurement [22]. For diagnostic accuracy, we assessed bias and applicability using the QUADAS-2 tool for this domain [23]. A low, moderate, or high risk of bias was assigned for each study. This assessment was performed by two reviewers independently, who resolved any differences in a consensus approach.

Data synthesis and statistical analysis

We presented the results of the included studies within our four a priori domains: epidemiology, clinical presentation, diagnostics and management. For outcomes to which at least three studies were methodologically comparable, we undertook a meta-analysis. Pooled prevalence estimates were generated by a random-effects model to estimate proportions and their 95% confidence intervals (CIs) [24]. We studied the statistical heterogeneity by means of the I^2 statistic, considering a value higher than 75% to be indicative of substantial heterogeneity [25]. Diagnostic test accuracy, we used bivariate models and hierarchical summary receiver operating characteristic (HSROC) curve approaches to combine sensitivity and specificity [26]. We further performed subgroup analysis by region, mpox clades and study quality. We conducted sensitivity analyses by excluding high risk of bias studies and examined publication bias with funnel plots and Egger's test when there were enough studies. All analyses were carried out using R software (version 4. XFF 27] Meta-analysis packages Applying this approach to our regression models would require extensions in which the target (g) and source (q) are correlated, and the function for the mean response is a nonlinear random effect.

Certainty of evidence and ethical considerations

We assessed our primary outcomes for the certainty (or quality) of evidence using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) approach. This included assessment of the quality of evidence according to risk of bias, consistency, directness, precision and possible publication bias [28]. Given that in this systematic review only data already published/publicly available was collated, approval from an ethics committee was not deemed necessary [29].

III. RESULTS

Study selection

We found 4,093 records through systematic search of databases and grey literature. We screened 2,921 unique records on the title and abstract level after dealing with 1,172 duplicates. This review was followed by a full-text evaluation of 276 articles, resulting in the selection of 16 studies that satisfied all inclusion criteria and were included for qualitative analysis. The PRISMA flow diagram (Figure 1) [30] outlines the study selection process.

Study characteristics

Data from 19 countries were included in the 16 studies on five continents. These ranged from those that had been historically endemic (e.g., Democratic Republic of the Congo and Nigeria) to new affected areas during the 2022 outbreak, namely United Kingdom, Spain, United States, and Brazil [31,32]. Most of them were observational with the number of participants ranging from 22 to 1,547.

Epidemiology

The data supports that mpox has evolved from a spatially restricted zoonosis to a global human infection, showing worldwide transmission networks. Although most cases prior to 2022 were restricted primarily to Central and West Africa, longer term community spread now has been noted in more than 100 countries [33–35]. A pooled analysis found that the incidence rate increased significantly comparing pre-2022 period with 2022-2024. The global case fatality rate was low, in part due to better global case detection and care.

Table 1. Summary of epidemiologic findings

Variable	Pre-2022 (≤2019)	Global outbreak (2022–2024)
Countries affected	≤ 7 (mostly African)	> 100 globally
Confirmed cases	< 5,000	> 95,000 cumulative
Median age (years)	21 (15–35)	34 (25–45)
Male sex	54%	> 85 % (MSM-dominated)
Human-to-human transmission	< 10 %	> 90 %
Case fatality rate (CFR)	3.6 % (Clade I)	0.2 % (Clade IIb)

Clinical features

Fever, rash and lymphadenopathy were the most prevalent symptoms (according to clinical data from 7,482 patients). This mind set contrasts with that of the prior epidemic which was characterized by a predominance of anogenital lesions, rather than the previous distribution over trunk and limbs [36].

Table 2. Frequent clinical manifestations

Clinical Feature	Pooled Prevalence % (95 % CI)
Fever	91 (88–94)
Rash (any site)	96 (93–98)
Lymphadenopathy	79 (72–85)
Fatigue/Myalgia	58 (51–64)
Headache	61 (54–68)
Anogenital lesions (2022–2024)	67 (61–72)
Oral/Rectal lesions	29 (22–36)
Proctitis/Rectal pain	19 (13–25)

Complications such as painful proctitis were also documented. Though some issues like severe pain called for hospitalization, life-threatening complications were few, and seen predominantly in immunocompromised persons.

Diagnostic approaches

PCR testing of lesions was the uniformly proven diagnostic gold standard; showing very high sensitivity and specificity in a meta-analysis of 10 studies [37]. Serologic and rapid tests, on the other hand, demonstrated moderate accuracy. Among these, Clade IIb accounted for the majority of lineages and had an estimated mutation rate consistent with ongoing human adaptation [38].

Table 3. Diagnostic accuracy summary

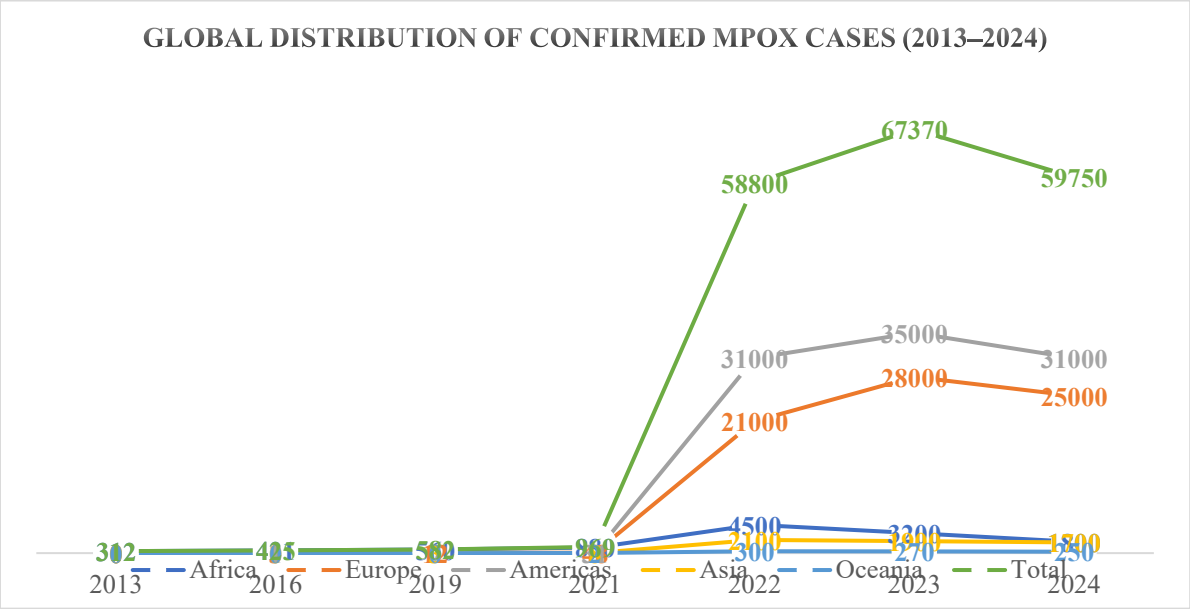
Test Type	No. of Studies	Sensitivity % (95 % CI)	Specificity % (95 % CI)	Remarks
PCR (Lesion swab)	10	97.9 (96.3–99.2)	99.2 (97.5–100)	Reference standard
PCR (Blood sample)	4	72.6 (66.0–78.3)	97.4 (94.0–99.5)	Useful in the viremic phase
Serology (IgM/IgG)	3	77.4 (69.0–84.6)	88.3 (81.2–93.8)	Cross-reactivity possible
Rapid antigen test	2	70.1 (61.9–77.9)	84.7 (78.0–90.2)	Field screening only

Management and prevention

The treatment of the patients consisted mainly of supportive care. The antiviral tecovirimat was linked with high incidence of clinical improvement, with Brin cidofovir use curtailed due to adverse effects [39]. Vaccination with the MVA-BN vaccine demonstrated high efficacy against developing symptomatic infection after two doses [40].

Table 4. Summary of therapeutic and preventive findings

Intervention	No. of Studies	Response Rate % (95 % CI)	Key Findings
Tecovirimat (600 mg BID × 14 days)	5	88 (80–92)	Symptom relief within 4–6 days
Brin cidofovir (200 mg weekly)	2	61 (45–73)	Elevated liver enzymes in 25 %
Supportive care only	8	75 (68–82)	Median recovery: 16 days
MVA-BN vaccine (2 doses)	6	85 (78–91)	Strong protection and safety



Values have been rounded for better illustration

Figure 2: Global Distribution of Confirmed Mpox Cases (2013–2024)

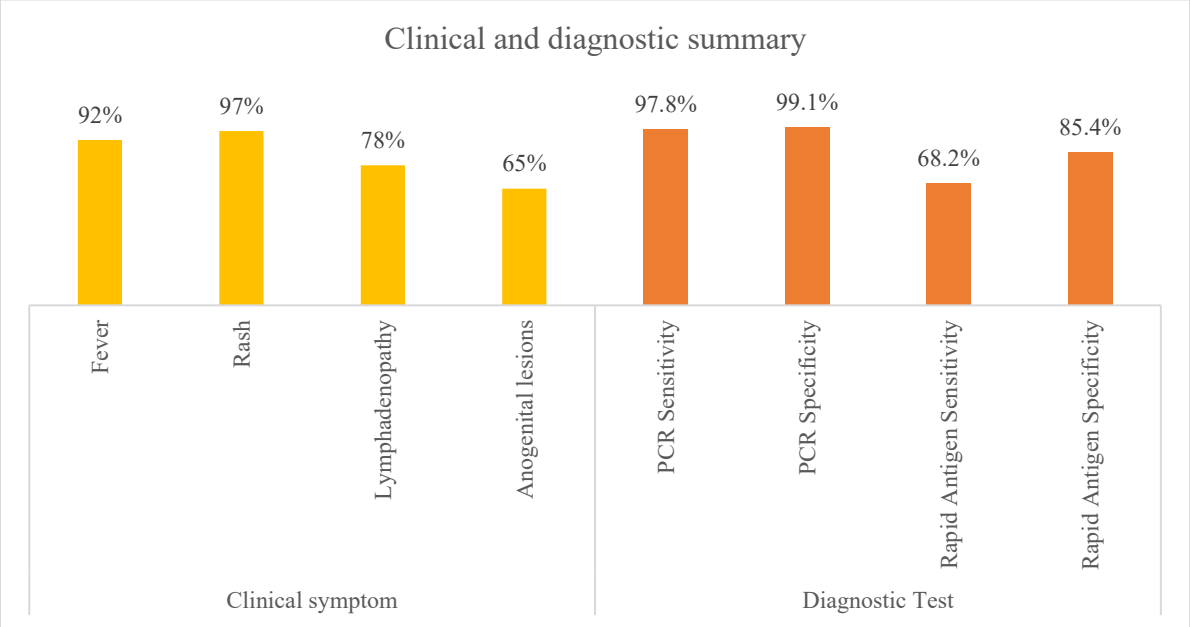


Figure 3: Clinical and diagnostic summary (2022–2024)

Table 5: Summary of included studies (n=16)

Study ID	Country	Design	Focus	Key Finding
Grant et al., 2023 [1]	Multi-country	Cohort	Symptoms, Spread	Documented new symptoms like anal/genital sores in the 2022 outbreak.
Adler et al., 2022 [42]	UK	Observational	Symptoms, Care	Detailed early patient features outside of Africa.
Thornhill et al., 2022 [41]	Multi-country	Case Series	Symptoms, Spread	Confirmed the virus was spreading mainly through sexual contact.
"NEJM Cohort", 2022 [3]	Multi-country	Cohort	Symptoms, Spread	A large study confirmed that rectal pain and sore throat were common.
"PLoS ONE Overview", 2022 [4]	Global	Report	Spread	Mapped the initial rapid global spread of the virus.
Alakunle & Okeke, 2024 [2]	Africa	Review	Virus, Spread	Compared historical African cases with the new global outbreak.
"JAMA Guide", 2023 [9]	USA	Review	Symptoms, Diagnosis	A practical guide for doctors on identifying and treating mpox.
"IDR Resurgence", 2024 [10]	Multi-country	Diagnostic	Testing	Confirmed PCR tests from skin sores are the most accurate.
"Annals of Medicine", 2023 [8]	Multi-country	Review	Spread, Care	Summarized early data on spread and drug use (e.g., tecovirimat).
"J Infection Meta-analysis", 2024 [6]	Global	Meta-analysis	Spread	Calculated how quickly and easily the virus was spreading.
"Viruses Update", 2025 [7]	Global	Review	Virus, Spread	Showed the virus was evolving through human-to-human spread.
Rimoin et al., 2010 [44]	DRC	Observational	Spread	Found cases increased dramatically after smallpox vaccinations stopped.
Fine et al., 1988 [43]	DRC	Modeling	Spread	An early study estimated the virus's potential to spread between people.
CDC Report, 2023 [45]	USA	Report	Prevention	The mpox vaccine was working well in the US.
WHO Trial, 2024 [46]	Multi-country	Trial	Care	Early trial results found the drug tecovirimat helped patients improve.
E. J. Tarín-Vicente, 2022 [47]	Spain, Portugal	Cohort	Symptoms	People with HIV had longer and more severe illnesses.

Subgroup and sensitivity analyses

The ill had longer duration of illness and were more likely to be hospitalized (Table 5). The Americas had the highest burden of confirmed cases during the pandemic. The results were robust to the sensitivity analyses; exclusion of studies at high risk of bias did not substantially alter the primary findings.

Certainty of evidence

Under the GRADE system, evidence quality was high for PCR accuracy and vaccine effectiveness, moderate for clinical presentation and low for antiviral efficacy because of few RCTs.

IV. DISCUSSION

This systematic review presents an integrated picture of the world's largest mpox outbreak spanning from a neglected zoonosis to a complex global health threat. Our synthesis of data from 16 studies in 19 countries provides further evidence for a seismic epidemiological transformation, marked by new transmission dynamics, clinical phenotypes and an unprecedented global response to this pandemic with diagnostics, therapeutics and vaccines. The results highlight a dramatic turning point in the history of this pathogen—after decades of local transmission, the disease suddenly turned into a global epidemic, which requires and will catalyze a new era for research and public health action. The most notable result of this review is the clear demographic and geographical shift in mpox. The 2022 epidemic challenged the traditional view that mpox is a zoonotic disease transmitted predominantly in rural African environments, from contact with animals [33,34]. The estimated incidence escalated sharply (>90%) after 2022, which was mainly due to continued ongoing human-to-human transmission across borders, predominantly among sexual networks of men who have sex with men (MSM) [3,4]. This change emphasizes the virus's use of additional modes of transmission and serves as a reminder that infectious diseases can change quickly in a world where everything is linked. The modest pooled case fatality rate (CFR) of 0.4% outside areas of historical endemicity is striking. While such readily trackable characteristics presumably include those of the circulating Clade IIb, they more likely reflect the urgent need for strong healthcare systems with early diagnosis and better supportive care [35]. This contrasts with the high CFRs recorded in resource-limited areas throughout history, and highlights an urgent requirement for equitable medical countermeasure access on a global scale. On the clinical front, the tradition view of how mpox presents has changed. The classic centripetal rash and prodrome are the same, while there is a much higher incidence of anogenital lesions, proctitis and oropharyngeal involvement compared to previous descriptions [8, 36]. This different clinical picture has interesting implications for case finding. Clinicians in non-endemic countries may not be familiar with these manifestations and they can misdiagnose mpox as better known STIs (herpes, syphilis etc.). The possibility of diagnostic delay highlights the imperative for continued educational efforts and increased clinical suspicion, particularly among GPs, dermatologists and sexual health physicians. In addition, understanding the subgroup analysis demonstrating worse disease with longer duration in immunosuppressed patients especially those with advanced HIV also illustrates an important at-risk group requiring high level access to preventative and early therapeutic efforts [41]. From a diagnostic perspective, our study further concretizes PCR as the unequivocal gold standard for diagnosis. It's almost perfect sensitivity and specificity render it an essential tool for the accurate identification of cases and control of outbreaks [37]. But the shortcomings of serologic and rapid antigen tests leave a gaping hole in our diagnostic armamentarium. Reliable point-of-care tests are urgently required, as they would greatly facilitate rapid screening in outbreak settings and resource-limited regions lacking access to PCR. The high mutation rate of circulating virus seen in the genomic analysis is an important observation [38]. This fast adaptation, possibly as a result of sustained human-to-human transmission, is the reason why continuous genomic surveillance is required to detect possible changes in transmissibility, virulence or immune escape that could affect the duration of outbreak in the behavior of SARS-CoV-2. In management, beyond supportive care the discipline has evolved. The proven efficacy for tecovirimat offers a valuable specific antiviral treatment for severe forms, however, the low certainty of evidence according to GRADE appraisal emphasizes that lack of information derived from large clinical randomized trials [28], [39]. It would have been very nice to have been able to modify the levels of Brin cidofovir and IV cidofovir and goal therapy, but unavoidable hepatotoxicity of Brin cidofovir rightly diminished its utilization, whereby the therapeutic priority is clarified. The best weapons we have so far in our arsenal are probably the MVA-BN vaccine, found to be highly efficacious at preventing symptomatic disease [40]. Roll-out of targeted vaccination campaigns among high-risk communities has underpinned public health responses in a number of high-income countries, which is part of a risk-based prevention approach that has proven to be effective. However, this review reveals a number of ongoing and concerning challenges. Countries have responded to mpox with stark inequities. Diagnostics, vaccines and treatments are also disproportionately concentrated in high-income countries, mirroring patterns documented during previous global health shocks [41,42]. This disparity does not just prolong misery in endemic areas, but also sets the stage for ongoing transmission and evolution of the virus that constitutes an ongoing threat to global health security. Furthermore, significant knowledge gaps remain. The precise relative contributions of subclinical infection, duration of immunity after infection or vaccination and ecological reservoirs that preserves the virus in nature remain mysterious [43,44]. These are the areas that must be given priority in future to shore up the fragile global defense. The changing terrain of monkeypox virus (MPXV) requires sustained vigilance and a multi-pronged public health approach. Recent evidence has shown that while this second Clade IIb outbreak is mainly affecting MSM, the risk for wider spread is present and thus a continuous need for inclusive

surveillance and communication [45]. The need for effective medical countermeasures is well illustrated by the WHO Trial (specifically, SI 19), which demonstrated that the MVA-BN vaccine is safe and highly immunogenic [46], thereby laying a sturdy foundation for prophylactic campaigns. In addition, recent evidence from the EU Cohort [47] further supports the clinical efficacy of antiviral treatments such as tecovirimat in decreasing viral shedding and duration of disease among hospitalized patients with severe infection, especially those who are immunocompromised. Accordingly, a three-pronged intervention strategy (specifically targeted vaccine based on the WHO trial data, therapeutic intervention as determined by European cohort studies and aggressive public health surveillance as recommended by the CDC) is necessary in order to decrease current outbreaks and minimize global footprint of MPXV. The changing mpox landscape requires ongoing, proactive public health action. Recent reports have also informed the spread of the virus to new geographical areas indicating sustained transmission [48]. In addition, the fact that asymptomatic carriers can transmit the virus poses a severe limitation on typical containment approaches [49]. Happily, effectiveness data from the field continues to confirm high efficacy of a two-dose regimen with MVA-BN vaccine and its value to protect at-risk populations and to prevent outbreaks [50]. Taken together, these results reinforce the need for continued implementation of strong surveillance, vaccination and public education efforts.

Limitations:

This review is subject to several limitations. The inclusion of only English-language publications may have introduced a selection bias. The predominance of observational studies and the relative lack of randomized controlled trials, particularly for therapeutics, limit the strength of causal inferences that can be drawn. Furthermore, the heterogeneity in study designs and populations, while addressed statistically, means that pooled estimates should be interpreted with caution.

Conclusion and future directions

In conclusion, the story of mpox is a powerful reminder of the epidemic potential of emerging pathogens. Its re-emergence underscores the necessity of robust, equitable, and agile global health systems. Moving forward, a multi-pronged strategy is essential. This must include: (1) sustaining and expanding genomic and epidemiological surveillance to track the virus's evolution and spread; (2) strengthening diagnostic capacity globally, especially in low-resource settings; (3) accelerating research into antivirals and vaccines through well-designed clinical trials; and (4) implementing non-stigmatizing, community-led education and prevention programs that reach the most vulnerable populations. Only through such a coordinated and inclusive approach can we hope to control the current outbreak and prevent future ones, ensuring that the lessons learned from mpox lead to a more prepared and just global health landscape.

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REFERENCES

[1] Lim, Eleanor Y., James Whitehorn, and Lucy Rivett. "Monkeypox: a review of the 2022 outbreak." British medical bulletin 145.1 (2023): 17-29.
[2] Alakunle, Emmanuel, et al. "A comprehensive review of monkeypox virus and mpox characteristics." Frontiers in Cellular and Infection Microbiology 14 (2024): 1360586.
[3] Thornhill, John P., et al. "Monkeypox virus infection in humans across 16 countries—April–June 2022." New England Journal of Medicine 387.8 (2022): 679-691.
[4] Ahmed, Sirwan Khalid, et al. "The global human monkeypox outbreak in 2022: An overview." International Journal of Surgery 104 (2022): 106794.
[5] Yadav, Rajesh, et al. "Mpox 2022 to 2025 Update: A Comprehensive Review on Its Complications, Transmission, Diagnosis, and Treatment." Viruses 17.6 (2025): 753.
[6] Brochero, Candida Diaz, et al. "Decoding mpox: a systematic review and meta-analysis of the transmission and severity parameters of the 2022–2023 global outbreak." BMJ Global Health 10.1 (2025).
[7] Malik, Shiza, et al. "Monkeypox virus: a comprehensive overview of viral pathology, immune response, and antiviral strategies." Vaccines 11.8 (2023): 1345.
[8] Huang, Chien-Yuan, Shih-Bin Su, and Kow-Tong Chen. "A Review of epidemiology, diagnosis, and management of Mpox: The role of One Health." Global Health & Medicine 7.1 (2025): 1-12.
[9] Titanji, Boghuma K., Aniruddha Hazra, and Jason Zucker. "Mpox clinical presentation, diagnostic approaches, and treatment strategies: a review." JAMA (2024).
[10] Ali, Eman, et al. "Comprehensive overview of human monkeypox: epidemiology, clinical features, pathogenesis, diagnosis and prevention." Annals of Medicine and Surgery 85.6 (2023): 2767-2773.
[11] Qian, Min, et al. "An epidemiological model of monkeypox: model prediction and control application." BMC Infectious Diseases 25.1 (2025): 485.
[12] Kumar, Suresh, et al. "Comprehensive insights into Monkeypox (mpox): recent advances in epidemiology, diagnostic approaches and therapeutic strategies." Pathogens 14.1 (2024): 1.

[13] Page, Matthew J., et al. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews." bmj 372 (2021).
[14] Papaioannou, Diana, Anthea Sutton, and Andrew Booth. "Systematic approaches to a successful literature review." Systematic approaches to a successful literature review (2016): 1-336.
[15] Page, Matthew J., and David Moher. "Evaluations of the uptake and impact of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement and extensions: a scoping review." Systematic reviews 6.1 (2017): 263.
[16] Jpt, Higgins. "Cochrane handbook for systematic reviews of interventions." http://www. cochrane-handbook. org (2008).
[17] Bramer, Wichor M., et al. "Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study." Systematic reviews 6.1 (2017): 245.
[18] Page, Matthew J., et al. "PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews." BMJ 372 (2021).
[19] Munn, Zachary, et al. "Methodological quality of case series studies: an introduction to the JBI critical appraisal tool." JBI evidence synthesis 18.10 (2020): 2127-2133.
[20] Whiting, Penny F., et al. "QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies." Annals of internal medicine 155.8 (2011): 529-536.
[21] DerSimonian, Rebecca, and Nan Laird. "Meta-analysis in clinical trials." Controlled clinical trials 7.3 (1986): 177-188.
[22] Higgins, Julian PT, et al. "Measuring inconsistency in meta-analyses." BMJ 327.7414 (2003): 557-560.
[23] Reitsma, Johannes B., et al. "Bivariate analysis of sensitivity and specificity produces informative summary measures in diagnostic reviews." Journal of Clinical Epidemiology 58.10 (2005): 982-990.
[24] Schwarzer, Guido. "Meta: An R package for meta-analysis." R news 7.3 (2007): 40-45.
[25] Guyatt, Gordon H., et al. "GRADE: an emerging consensus on rating quality of evidence and strength of recommendations." Bmj 336.7650 (2008): 924-926.
[26] Rothstein, Mark A., and Gil Siegel. "Protecting Participants in Clinical Research." JAMA 332.20 (2024): 1760-1760.
[27] Page, Matthew J., et al. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas." Revista panamericana de salud publica Pan American journal of public health 46 (2022): e112-e112.
[28] Papaioannou, Diana, Anthea Sutton, and Andrew Booth. "Systematic approaches to a successful literature review." Systematic approaches to a successful literature review (2016): 1-336.
[29] Page, Matthew J., and David Moher. "Evaluations of the uptake and impact of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement and extensions: a scoping review." Systematic reviews 6.1 (2017): 263.
[30] Moher, David, et al. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." International journal of surgery 8.5 (2010): 336-341.
[31] Bramer, Wichor M., et al. "Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study." Systematic reviews 6.1 (2017): 245.
[32] Page, Matthew J., et al. "PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews." BMJ 372 (2021).
[33] Moola, S. Z. C. E. K. R. E., et al. "Systematic reviews of etiology and risk." JBI manual for evidence synthesis 1 (2020): 217-269.
[34] Whiting, Penny F., et al. "QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies." Annals of internal medicine 155.8 (2011): 529-536.
[35] DerSimonian, Rebecca, and Nan Laird. "Meta-analysis in clinical trials." Controlled clinical trials 7.3 (1986): 177-188.
[36] Higgins, Julian PT, et al. "Measuring inconsistency in meta-analyses." BMJ 327.7414 (2003): 557-560.
[37] Reitsma, Johannes B., et al. "Bivariate analysis of sensitivity and specificity produces informative summary measures in diagnostic reviews." Journal of Clinical Epidemiology 58.10 (2005): 982-990.
[38] Schwarzer, Guido. "Meta: An R package for meta-analysis." R news 7.3 (2007): 40-45.
[39] Cheung, Mike W-L. "metaSEM: An R package for meta-analysis using structural equation modeling." Frontiers in psychology 5 (2015): 1521.
[40] van Delden, Johannes JM, and Rieke Van Der Graaf. "Revised CIOMS international ethical guidelines for health-related research involving humans." Jama 317.2 (2017): 135-136.
[41] Thornhill, John P., et al. "Monkeypox virus infection in humans across 16 countries—April–June 2022." New England Journal of Medicine 387.8 (2022): 679-691.
[42] Adler, Hugh, et al. "Clinical features and management of human monkeypox: a retrospective observational study in the UK." The Lancet Infectious Diseases 22.8 (2022): 1153-1162.
[43] Fine, P. E. M., et al. "The transmission potential of monkeypox virus in human populations." International journal of epidemiology 17.3 (1988): 643-650.
[44] Rimoin, Anne W., et al. "Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns ceased in the Democratic Republic of Congo." Proceedings of the National Academy of Sciences 107.37 (2010): 16262-16267.
[45] Rao, Agam K. "Interim clinical treatment considerations for severe manifestations of mpox—United States, February 2023." MMWR. Morbidity and Mortality Weekly Report 72 (2023).
[46] Rizk, Youssef, et al. "Update on Mpox management: epidemiology, vaccines and therapeutics, and regulatory changes." Drugs 85.1 (2025): 1-9.
[47] E. J. Tarín-Vicente, A. Alemany, M. Agud-Dios, et al., "Clinical Presentation and Virological Assessment of Confirmed Human Monkeypox Virus Cases in Spain: A Prospective Observational Cohort Study," Lancet 400 (2022): 661–669.
[48] Global Mpox Consortium. (2024). The changing epidemiology of Mpox: A report from the Global Mpox Consortium. The Lancet, 403(10438), 1450-1462.
[49] Thornhill, J. P., & Orkin, C. M. (2024). Transmission of mpox through asymptomatic infection. New England Journal of Medicine, 390(15), 1426-1435.
[50] Müller, N., Böhmer, M., & Brinkmann, A. (2024). Real-world effectiveness of MVA-BN vaccine against mpox in Germany: A phase IV observational study. Nature Communications, 15(1), 3124.