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Review

A critical review of mpox outbreaks, risk factors, and prevention efforts in Africa: lessons learned and evolving practices

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ARTICLE INFO

Keywords:

Mpox
Africa
Risk factors
Clinical presentation
Prevention measures

ABSTRACT

Objectives: In recent years, mpox, a zoonotic disease caused by the mpox virus, has transcended its primary association with Central and West Africa, emerging as a global public health concern. The virus poses a substantial threat, particularly, to vulnerable demographics such as young children and individuals with compromised immune systems. This critical literature review aimed to comprehensively evaluate the burden, risk factors, and current management strategies associated with mpox in Africa.

Methods: This critical literature review was guided by Jesson & Lacey's guidelines on conducting critical literature reviews. We searched PubMed and Google Scholar databases and websites of the World Health Organization and health ministries in different African countries. We included articles written in English and published between 2010 and 2023. The synthesis of findings involved several steps, including summarizing themes, integrating themes, and linking themes to research questions.

Results: A total of 25 articles were included in this review. The review revealed that mpox cases are concentrated in Central African countries. The risk factors for mpox identified include being in contact with bushmeat or rodents, not having been vaccinated against smallpox, being HIV-positive, and having close physical contact with someone with the disease. The clinical presentation of mpox revealed in this review includes a skin rash, fever, lymphadenopathy, headache, pruritus, sore throat, and body aches. Four themes arose on strategies to prevent and control mpox in Africa.

Conclusions: The prevention and control of mpox in Africa require an improvement in community education, vaccination, disease surveillance, and infection control measures.

Introduction

In recent years, mpox, a zoonotic disease caused by the mpox virus, has transcended its primary association with Central and West Africa, emerging as a notable global public health concern [1]. The disease is marked by a distinctive rash and flu-like symptoms. The virus poses a substantial threat, particularly, to vulnerable demographics such as young children and individuals with compromised immune systems [2].

Although mpox has been reported in various regions [3], its impact remains prominently concentrated in Africa. Endemic to several countries, outbreaks have inflicted significant morbidity and mortality across the continent, emphasizing the imperative to comprehend the disease's distinctive complexities within the African context [4]. This understand-

ing is fundamental for developing and implementing effective public health interventions.

Although existing research has delved into the exploration of mpox risk factors and clinical presentations [2,5]. The dynamic nature of the disease necessitates a continuous review of current evidence. Examining global experiences and best practices across the region provides invaluable insights for tailoring prevention and treatment strategies to the specific needs of African populations. This critical literature review aims to comprehensively evaluate the burden, risk factors, and current management strategies associated with mpox in Africa. Through an exhaustive examination of reported outbreaks, documented lessons, and best practices, we aim to inform evidence-based approaches capable of mitigating the impact of mpox outbreaks and safeguarding vulnerable communities.

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<https://doi.org/10.1016/j.ijregi.2024.100402>

Received 16 April 2024; Received in revised form 30 June 2024; Accepted 2 July 2024

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Methods

We conducted a critical literature review guided by Jesson & Laccy's guidelines on conducting critical literature reviews [6].

Clarity of the research question and objectives

The review will address three pivotal questions:

- i. What is the burden of mpox in Africa?
- ii. What are the specific risk factors and clinical presentations observed in African populations?
- iii. What documented lessons and best practices exist for preventing and treating mpox in Africa?

For this review, burden was defined as reported confirmed cases or outbreaks and associated mortality.

Developing a search strategy that is both comprehensive and focused

We used various search terms and databases to ensure that we captured all the relevant literature to address our research question. We used key search terms including 'Mpox infections', 'Epidemiology', 'sub-Saharan Africa', 'Disease outbreaks', 'Risk factors', 'Signs', 'Symptoms', 'Diagnosis', 'Surveillance', 'Prevention and control', 'Public health practice', and 'Evidence-based medicine'. We searched for articles (primary research studies, reviews, opinion pieces, and reports) written in English and published between 2010 and 2023. We searched two extensive databases, PubMed and Google Scholar, as well as the websites of the World Health Organization and health ministries in different African countries. Examples of search strategies used for the research question include the following:

- (i) (Mpox Virus Infections/epidemiology[Mesh] OR Mpox[Mesh]) AND (Africa, Sub-Saharan/epidemiology[Mesh]) AND (Disease Outbreaks/epidemiology[Mesh] OR Surveillance, Epidemiologic [Mesh])
- (ii) (Mpox Virus Infections/risk factors[Mesh] OR Risk Factors[Mesh]) AND (Mpox Virus Infections/complications[Mesh] OR Signs and Symptoms[Mesh] OR Diagnosis, Differential [Mesh]) AND (Africa, Sub-Saharan/epidemiology[Mesh]) AND (Population Groups[Mesh])
- (iii) (Mpox Virus Infections/prevention and control[Mesh] OR Public Health Practice[Mesh] OR Best Practices[Mesh]) AND (Mpox Virus Infections/therapy[Mesh] OR Evidence-Based Medicine [Mesh]) AND (Africa, Sub-Saharan/epidemiology[Mesh])

Critically evaluate the quality of the studies included in the review

Critical evaluation of the included studies was not conducted due to the nature of most studies identified. The review primarily included reports (e.g. World Health Organization [WHO] situation reports) that do not typically use rigorous methodologies assessed in critical appraisal. Therefore, the review shifted toward summarizing and synthesizing reported findings rather than critically appraising their methods.

Identifying the key themes and arguments in the literature

We used an iterative process involving coding, thematic analysis, and reflective discussions to identify key themes. Each included study was systematically coded based on relevant aspects such as research questions, methodology, findings, and conclusions. Codes were developed inductively from the data and refined iteratively as new patterns emerged. After that, the codes were grouped into broader themes based on similarities, connections, and recurring patterns. We utilized constant comparison techniques to ensure consistency and refine theme definitions. Regular discussions were held among reviewers to discuss emerging themes, resolve discrepancies, and ensure a comprehensive understanding of the

literature. Disagreements among researchers were addressed through transparent and documented procedures. The review acknowledges and presents diverse perspectives on the topic, highlighting areas of consensus and disagreement among researchers. This approach provided a nuanced understanding of the current state of knowledge.

Synthesizing the findings and drawing conclusions

The synthesis of findings involved several steps including summarizing themes, integrating themes, and linking themes to research questions. Each identified theme was concisely summarized, capturing the key insights and evidence supporting it. Interrelationships between themes were explored, and a cohesive narrative was developed to present the overall picture emerging from the literature. Each theme was explicitly linked to the original research questions, demonstrating how the literature addressed each question.

Conclusions were carefully drawn based on the synthesized findings and aligned with the predefined research questions. We considered the strength of evidence, contextualization, and implications for practice and policy. The conclusions were based on the weight of evidence provided by the included studies, acknowledging variations in study quality and potential limitations. The conclusions considered the broader context of mpox in Africa, including socio-economic and public health realities. The reviewers also drew practical implications for public health interventions, prevention strategies, and treatment approaches based on the synthesized evidence.

Limitations of the review

The search strategy had several limitations, one of which is that only a few databases were used (PubMed and Google Scholar) along with the websites of WHO and African health ministries, making it possible that some relevant articles were missed. This might have resulted in missing some relevant articles published in other databases or non-governmental organisations' websites. Another limitation is that only articles published in English were considered, which might have introduced a language bias. This could have excluded relevant research conducted in languages such as French and Portuguese, which are commonly used in many African countries. For instance, a WHO report [7] highlighted that the French-speaking Democratic Republic of the Congo (DRC) reported the most (99.6%) of the confirmed mpox cases in April 2024. These limitations restrict the generalizability of the findings and highlight the need for further research incorporating a wider range of languages and sources. Future reviews could benefit from including studies published in other languages, such as French, and by searching additional databases specific to public health in Africa. Some of the studies included in this review were retrospective studies, making it possible that some of the findings were affected by recall bias.

Finally, although mpox confirmatory tests are available worldwide, there are concerns about Africa's capacity to diagnose and contain the disease. The challenges faced by Africa include a lack of adequate laboratory infrastructure and health care workers, weak disease surveillance systems, and a lack of knowledge among health care workers and communities about mpox. These challenges were cited in several of the manuscripts and reports available on mpox outbreaks.

Results

The literature searches yielded a total of 193 articles. Of these, only 25 articles were included in this review.

Review question 1

Seven African countries have reported mpox cases since 2010. More details are provided in [Table 1](#).

The burden of mpox in Africa appears to be concentrated in specific regions and fluctuating over time. Several Central African countries, in-

Table 1
Reported suspected and confirmed cases of human mpox and related deaths in Africa, 2010-2023.

Country	Year	Suspected cases	Confirmed cases ^a	Deaths
Benin	2022	0	3	0
Cameroon	2018	NA	2	0
	2019	NA	1	0
	2020	NA	2	0
	2021	NA	4	0
	2022	0	18	3
	2023	0	27	0
Central African Republic	2010	0	1	0
	2012	0	2	0
	2015	3	4	4
	2016	7	4	2
	2017	1	6	0
	2018	5	28	0
	2019	18	15	2
	2020	2	8	0
	2021	25	28	2
	2022	0	16	0
	2023	0	14	1
Democratic Republic of the Congo	2016	3750	NA	NA
	2017	2500	NA	NA
	2018	3784	NA	78
	2019	5288	NA	107
	2020	6216	NA	222
	2021	2841	NA	76
	2022	0	279	0
	2023	0	966	2
Ghana	2022	0	121	4
	2023	0	6	0
Liberia	2017	NA	2	0
	2022	0	6	0
	2023	0	7	0
Mozambique	2022	0	1	1
Nigeria	2017	202	88	5
	2018	117	49	3
	2019	98	47	1
	2020	35	8	0
	2021	98	34	0
	2022	0	763	7
	2023	0	80	2
Republic of the Congo	2017	88	87	6
	2019	NA	2	0
	2022	0	5	0
	2023	0	21	2
Sierra Leone	2014	NA	1	1
	2017	NA	1	0
	2019	NA	1	0
	2021	NA	1	0
South Africa	2022	0	5	0

^a Laboratory confirmed cases

cluding the DRC and the Central African Republic, show higher confirmed cases than other regions. Notably, the DRC reported over 2500 cases each year between 2016 and 2020, with the highest number at 6216 cases in 2020. The same country reported over 220 deaths in 2020 alone. In contrast, countries such as Cameroon and Nigeria have a lower and more stable burden of mpox, with confirmed cases ranging from one to four per year in Cameroon and eight to 98 cases in Nigeria. Overall, mortality associated with mpox appears to be low across the countries listed, with no deaths reported in South Africa and Sierra Leone and sporadic occurrences in other countries.

Review question 2

A total of 11 articles [8–18] were included in research question 2. Of these, four [9,12,13,18] were case studies, two [14,15] retrospective

cohorts with case controls, four [8,10,11,16] were review articles, and one [17] cohort. More details are presented in Table 2.

Risk factors

Increased contact with wildlife emerged as a significant risk factor, highlighted in studies from Nigeria and the Central African Republic. Activities such as hunting, trading, and consuming wild animals were mentioned. Studies from Nigeria [16,17] highlight contact with bushmeat and activities such as hunting and trading as potential risk factors, whereas a study by Nakoune et al. [13], reported a case from the Central African Republic, which was linked the infection to handling rodents.

The lack of vaccination against smallpox and immunosuppression also emerged as key risk factors for mpox. A study from the Central African Republic [12] found that 80.8% of patients with mpox were unvaccinated against smallpox. HIV coinfection was identified as a risk factor for more severe illness. A Nigerian study [16] observed more severe illness in individuals with HIV.

Socio-economic factors also emerged as key determinants for mpox. Individuals living in underserved communities with limited access to health care or accurate information about mpox might face increased risk due to delayed diagnosis and access to prevention measures. Close physical contact, particularly, in crowded settings, increased transmission risk. A study in the DRC [15] identified factors such as crowded living conditions and sharing utensils as potential contributors to transmission.

Clinical presentations

The most common presentation was skin rash, described as maculopapular or vesiculopustular [11,16–18]. Fever and lymphadenopathy were also present in most reported cases [11,16–18]. Additional symptoms included headache, pruritus, sore throat, and body aches [9,11–13,16–18]. More details are presented in Table 2.

Review question 3

A total of 12 articles provided a summary of key lessons learned and best practices for preventing and treating mpox in the African context [4,19–29] and grouped into four themes: surveillance and early detection, prevention, case management and treatment, and health systems.

Theme 1. Surveillance and early detection

Building resilient systems is crucial. Establishing robust laboratory networks with timely reporting to the WHO strengthens outbreak detection [29]. Implementing sensitive case definitions, including fever and specific skin lesions, was also shown to improve surveillance accuracy [23]. Furthermore, a “One Health” approach, bridging human, animal, and environmental sectors, facilitates comprehensive outbreak investigation and risk assessment, as advocated by Ogunleye et al. [20] and Nacheqa et al. [26].

Theme 2. Prevention

Vaccination plays a vital role. Using “ring vaccination” strategies effectively targeting high-risk contacts, as highlighted by Ogunkola et al. [24] is crucial. Equitable access to vaccines, however, remains a challenge, requiring attention to supply chain issues and potential staff fatigue [25].

Public health education empowers individuals. Raising awareness about risk factors, transmission modes, and preventive measures is essential, as emphasized by the Nigeria Centre for Disease Control [22]. Addressing stigma and discrimination faced by vulnerable groups, particularly, men who have sex with men and transgender individuals, is crucial, as highlighted by Dzobo et al. [19].

Reducing animal-human contact also emerged as a critical component of prevention. As outlined by the Nigeria Centre for Disease Control, key practices include avoiding contact with wild animals and practicing good hygiene around domestic animals [22]. In addition, research to fill knowledge gaps in zoonotic transmission dynamics is vital [20].

Table 2
Characteristics of included studies on clinical presentation and risk factors.

Title	Country	Study design	Data period	Patient characteristics	Risk factors	Clinical presentation
Alakunle et al. [8]	Nigeria	Review	2017 to 2019	Age affected: 21-40 years (median age of 30) Male-to-female ratio 3:1	Lack of Oral Polio Vaccine infection exposure (Not receiving small pox vaccination) Immunosuppression due to HIV coinfection Trade in rodents which increased A young population	n/a
Besombes et al. [9]	Central African Republic	Case reports	2018	Age: 5 months to 25 years Sex: female	Intrafamilial transmission	Maculopapular rash on the palms of their hands Lesions Soles of the feet Fever
Ekpunobi et al. [10]	Nigeria	Review	2017 to 2022	Male: 66%	Growing contact between humans and wildlife due to deforestation, conflict, and poverty especially in North-Eastern Nigeria Inadequate surveillance and disease monitoring Increased mobility Uncontrolled contact between humans and reservoir animals for MPXV	n/a
Kalthan et al. [12]	Central African Republic	Case reports	2016	Most affected age was below 10 years and 21-30 years Men = 53.8% Five of the 26 (19.2%) patients had the smallpox vaccination scar	Lack of smallpox vaccination: unvaccinated individuals with 80.8% patients with MPXV having no vaccine Immunosuppression due to HIV coinfection Trade in rodents which increased A young population	Fever in all patients Skin rashes in all patients Pruritus and cervical and/or inguinal adenopathy observed in 46.2% and 34.6% of patients, respectively
Nakoune et al. [13]	Central African Republic	Case reports	2015 to 2016	n/a	Killing and cutting up a rodent known locally as "cibissi" and identified as Thryonomis Occupationally-acquired due to failure to use personal protective equipment.	Cutaneous lesions Fever Headache Cervical adenitis Severe facial edema and bilateral conjunctivitis Cervical and inguinal lymphadenopathy Maculopapular rash
Nolen et al. [15]	Democratic Republic of the Congo	Retrospective cohort and case-control	2013	Men (64%)	Household level 67% of those affected were aged 15 years and above ($P = 0.018$), No significant difference in vaccination against smallpox ($P = 0.097$), Room sharing ($P < 0.001$), Bed sharing ($P = 0.001$), Sharing food on same dish ($P < 0.005$) Drinking on the same cup ($P = 0.003$) Community level Sleeping at the floor ($P = 0.032$), Preparation of wild animal for consumption ($P = 0.049$)	n/a
Nolen et al. [14]	Democratic Republic of the Congo	Retrospective cohort and case-control	2013	Median age of 10 years (range 4 months–68 years) Males = 57.1%	n/a	Active lesions (57.7%)
Ogoina et al. [16]	Nigeria	Review	2017 to 2018	Age: 28 days to 54 years (median, 32 years) Male: 77.5%	Patient with HIV coinfection had larger skin lesions, more prolonged illness, and higher rates of genital ulcers and bacterial superinfection than the other	In 40 cases, skin rash ($n = 40$), fever ($n = 36$), lymphadenopathy ($n = 35$), genital ulcer ($n = 25$), body aches ($n = 25$), headache ($n = 19$), sore throat ($n = 18$), pruritus ($n = 15$), and conjunctivitis and photophobia ($n = 9$) Skin rashes were more apparent on limbs and face
Ogoina et al. [17]	Nigeria	A cohort study	2022 to 2023	Adults (84%), Males (71%)	Education ($P = 0.0048$)	HIV positive, fever, rash, concomitant varicella zoster virus infection, headache, malaise, pruritus, sore throat, poor appetite, painful sores, mouth sores, cough, catarrh conjunctivitis, vomiting, diarrhea, light sensitivity, site of first rash, anogenital or mouth rash, non-mucosal skin rash

(continued on next page)

Table 2 (continued)

Title	Country	Study design	Data period	Patient characteristics	Risk factors	Clinical presentation
Yinka-Ogunleye et al. [18]	Nigeria	Case reports	2017	21-40 years of age; median 30 years of age, male-to-female ratio 2:1	Contact with a neighbor's monkey 1 month before symptoms were reported although not firmly associated with the cases. Intrafamilial transmission was reported. Secondary attack transmission	Papulopustular rashes on the trunk, face, palms, and soles of the feet. Subsequent, he developed umbilication, ulcerations, crusting, and scab formation. Oral and nasal mucosal lesions and ulcers and accompanying generalized lymphadenopathy
Yinka-Ogunleye et al. [11]	Nigeria	Review	2017 to 2018	Age: 2 days to 50 years (median age was 29 years) Males were 69%	Human to human transmission in prison, Multiple source transmission in community	Vesiculopustular rash to all people; fever, pruritus, headache, and lymphadenopathy were also common. For the rashes, although the parts of the body were attacked, the face was the most affected

MPXV, mpox virus.

Theme 3. Case management and treatment

Supportive care and infection control go hand-in-hand. Implementing isolation and standard precautions in health care protects medical personnel and other patients [28,29]. In addition, providing proper hygiene education and lesion care guidance empowers patients for self-management [22]. Antiviral therapy offers additional support. As suggested by Mbrennga et al. [21], considering tecovirimat for high-risk or severe cases and closely monitoring its safety and efficacy can be beneficial. Finally, advocating for broader access to effective and safe treatment options requires continued effort, as stressed by the WHO [28,29].

Theme 4. Health systems

Investing in research and development strengthens Africa's long-term investment in combating mpox. Addressing knowledge gaps in transmission, diagnostics, and vaccine development is critical [20]. Fostering research collaboration and generating evidence for effective interventions pave the way for better prevention and treatment strategies.

Strengthening health care systems is equally important. Enhancing laboratory capacity for early diagnosis and confirmation improves response times, as Precious et al. emphasize [27]. In addition, increasing infrastructure, human resources, and funding for outbreak response equips health care systems to handle future challenges, as highlighted by Moyo et al. [4]. Developing and implementing comprehensive national response plans aligned with the WHO guidance ensures a coordinated and effective approach to outbreaks.

Discussion

This review revealed that risk factors associated with mpox in Africa include being in contact with bushmeat or rodents, not having been vaccinated against smallpox, being HIV-positive, and having close physical contact with someone with the disease. These results are consistent with a study conducted in the DRC during the outbreak that occurred in 1996-1997. The study found that consuming bushmeat and having close physical contact with a person who was ill were risk factors for mpox. These results are tenable because the disease can be transmitted from animals to people through biting or direct contact with the lesions or bodily fluids of the infected animal. Human-to-human transmission happens when a person comes into close contact with an infected individual's bodily fluids, contaminated objects, or respiratory droplets [29].

The clinical presentation of mpox revealed in this review includes a skin rash, fever, lymphadenopathy, headache, pruritus, sore throat, and body aches. Although typically milder, the signs and symptoms are similar to smallpox [30]. Symptoms that patients usually experience include fever, headache, backache, muscle aches, swollen lymph nodes, and weariness and discomfort. During the prodromal stage of the illness, lymphadenopathy is a clinical characteristic that helps differenti-

ate it from chickenpox or smallpox [31]. Within 1-3 days after the start of the fever, a vesicular and pustular rash resembling smallpox develops. Although it can sometimes occur in other body areas, the face is where this rash usually starts. The rash is papular at first; however, after that, there is vesiculation, pustulation, and ultimately crusting. The face, head, trunk, and limbs all experience these various rash stages simultaneously. Usually, the disease lasts between 2 and 4 weeks [30]. The clinical presentation reported in European countries has been similar to that reported in this review [32]. However, laboratory tests are needed to confirm the infection [33].

Several prevention methods were identified in this review. These include early detection and surveillance, vaccination, public health education, reducing animal contact, improving infection control measures during outbreaks, and strengthening health systems. Africa must bolster its mpox surveillance systems to contain the disease at an early stage. This can be accomplished by ensuring that research that can be applied to disease surveillance is promoted at academic institutions. During epidemics, disease surveillance data can also be gathered via demographic monitoring sites, which are accessible in most African countries. To guarantee that the condition is appropriately described, statistics on morbidity and mortality should be communicated among departments within a country [34]. To enhance the systematic reporting of the disease, mpox reporting should likewise be made mandatory. The implementation of contact tracing is also necessary because it will facilitate the identification and monitoring of those exposed to mpox for symptoms and the provision of vaccination for those deemed to be at a high risk. To make sure that surveillance operations are carried out correctly, they should be periodically supervised [35]. Given the excellent coverage of cell phone services across the continent, the continent could also use digital disease surveillance, which uses data created outside the public health system for disease surveillance [34]. In addition to human mpox surveillance, animal mpox surveillance should be ongoing. High-risk places in the human-animal interface, such as farms, wildlife parks, zoos, and markets that sell bush meat, should be the focus of animal surveillance [36].

Early notification of anticipated outbreaks is necessary to enable communities to make preparations and take preventive action, which will lower morbidity and mortality [34]. Risk messaging should be disseminated to the general public and particular high-risk groups, such as minors, immunocompromised individuals, and sex workers [37]. Information about minimizing human contact with suspect animals, discouraging the sale or consumption of animals discovered dead, and averting physical contact with individuals with mpox should be the main focus of mpox educational programs. Frequent handwashing, getting medical attention as soon as a suspected case arises, and fully boiling animal food products before eating are other important recommendations that must be communicated to communities [38]. Although some rural regions may not have enough infection prevention and control

procedures, health care facilities and patients' homes can, nevertheless, adopt preventive measures such as contact precautions, proper cleaning, and limited patient contact [35].

Conclusion

In recent years, mpox has transcended its primary association with Central and West Africa, emerging as a notable global public health concern. The risk factors associated with mpox in Africa include being in contact with bushmeat or rodents, not having been vaccinated against smallpox, being HIV-positive, and having close physical contact with someone with the disease. The clinical presentation of mpox revealed in this review includes a skin rash, fever, lymphadenopathy, headache, pruritus, sore throat, and body aches. However, laboratory tests required to confirm the diagnosis of mpox. Some strategies that can be used in Africa to prevent and control mpox include early detection and surveillance, vaccination, public health education, reducing animal contact, improving infection control measures during outbreaks, and strengthening health systems.

Declarations of competing interest

The authors have no competing interests to declare.

CRedit authorship contribution statement

Godfrey Musuka: Conceptualization, Writing – original draft. **Enos Moyo:** Writing – original draft. **Nigel Tungwarara:** Methodology, Writing – review & editing. **Malizgani Mhango:** Methodology, Writing – review & editing. **Gashema Pierre:** Writing – review & editing. **Eric Saramba:** Writing – review & editing. **Patrick Gad Iradukunda:** Writing – review & editing. **Tafadzwa Dzinamarira:** Writing – review & editing.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

Ethical approval for this review was not required.

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