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Challenges and Strategies for MPOX Management in Low Resource Settings
Défis et stratégies pour la gestion du MPOX dans les environnements à faibles ressources

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ABSTRACT

Mpox remains a persistent threat in low-resource settings, where overstretched healthcare systems, inadequate laboratory infrastructure, and limited vaccine availability complicate control efforts. Diagnosing Mpox in such contexts is often delayed by fragmented supply chains, unreliable power sources, and insufficient numbers of trained personnel. In addition, geographic inaccessibility and high out-of-pocket costs impede patients from seeking timely care. Sociocultural challenges—particularly stigma, misinformation, and vaccine hesitancy—further undermine prevention strategies. Humanitarian crises, characterized by overcrowding, malnutrition, and disrupted healthcare services, amplify disease spread by exacerbating vulnerabilities and impeding coordinated responses.

To address these multifaceted barriers, strengthening diagnostic capacity through the deployment of point-of-care tests, mobile laboratories, and targeted training programs emerges as a critical priority. Concurrently, improving healthcare access via task-shifting approaches and infrastructural investments can help integrate Mpox management into essential health services. Equitable vaccine distribution—bolstered by international partnerships, cold chain innovations, and community-based education—holds significant promise for curbing transmission. Ultimately, robust community engagement initiatives that emphasize culturally tailored public education campaigns and localized surveillance can reduce stigma, increase awareness, and enhance early detection. By adopting these targeted strategies, low-resource regions can build resilience against Mpox outbreaks and better prepare for future public health emergencies.

Keywords: *Mpox, challenges, management, point-of-care tests*

ABSTRAIT

Le mpox demeure une menace dans les milieux à faibles ressources, avec des systèmes surchargés, des laboratoires insuffisants et un accès limité aux vaccins. Le diagnostic tarde à cause de chaînes d'approvisionnement fragmentées, d'énergie peu fiable et du manque de personnel formé. L'inaccessibilité géographique et des coûts élevés dissuadent les patients. La stigmatisation, la désinformation et la réticence vaccinale affaiblissent la prévention, tandis que les crises humanitaires — surpopulation, malnutrition, perturbation des soins — favorisent la propagation en accentuant les vulnérabilités.

Pour surmonter ces obstacles, il faut renforcer le diagnostic par des tests sur le terrain, des laboratoires mobiles et des formations ciblées. Améliorer l'accès aux soins par la délégation de tâches et des investissements structurels permet d'intégrer la gestion du mpox aux services essentiels. Une distribution équitable des vaccins, avec partenariats internationaux, innovations dans la chaîne du froid et éducation communautaire, peut freiner la transmission. Un engagement communautaire fort, avec des campagnes éducatives et une surveillance locale, réduit la stigmatisation, accroît la sensibilisation et améliore la détection précoce. En adoptant ces stratégies, les régions à faibles ressources renforceront leur résilience face aux flambées de mpox et se prépareront aux urgences sanitaires.

Mots-clés: *Mpox, défis, gestion, tests sur le terrain.*

INTRODUCTION

Mpox, formerly known as monkeypox, is a zoonotic viral disease first identified in humans in 1970 in the Democratic Republic of Congo. For decades, it was considered endemic to Central and West Africa, where it largely affected populations living in proximity to animal reservoirs. However, recent global outbreaks, including the 2022–2023 surge that spread to over 100 countries, have highlighted its potential for widespread transmission. As of 2024, mpox has been reported in 79 locations worldwide, with 21,430 confirmed cases spanning both clade I and clade II variants. Notably, 11,911 cases occurred in regions affected only by clade I, while clade II accounted for 5,813 cases across 62 locations. Additionally, 3,702 cases involved co-circulation of both clades in seven locations (1). These statistics underscore the persistent burden of Mpox and the pressing need for targeted interventions, particularly in low- and middle-income countries (LMICs).

LMICs face unique challenges in addressing infectious disease outbreaks like Mpox due to longstanding systemic limitations. These regions, home to much of the global population, are characterized by constrained healthcare funding, high disease burdens, and inequities in healthcare access (2,3). For instance, Nigeria, the most populous country in Africa, has reported Mpox outbreaks since 2017, with significant implications for public health and disease surveillance systems (4,5). From 2021 to 2024, Nigeria recorded 4,887 suspected cases, and 1,018 confirmed cases, with outbreaks affecting all 39 states. The largest outbreak occurred in 2022, with 2,123 suspected cases and 762 confirmed cases (6). Nigeria's efforts to improve public health surveillance challenges such as underfunded health infrastructure, inadequate laboratory capacity, and limited vaccine access persist (7,8). These issues are not unique to Nigeria but reflect broader structural vulnerabilities seen across LMICs.

Mpox transmission occurs through close contact with infected individuals, bodily fluids, contaminated materials, or zoonotic exposure to infected animals. Its symptoms include fever, lymphadenopathy, and a rash that progresses through distinct stages, often leaving permanent scars. Although most cases are self-limiting, severe disease occurs more frequently in children, pregnant individuals, and those with compromised immunity, particularly in areas with high rates of untreated HIV infection (9–11). The intersection of mpox and HIV is particularly concerning in low-resource settings. Individuals living with HIV, especially those with advanced disease or unsuppressed viral loads, are at heightened risk of severe Mpox outcomes, including prolonged illness, extensive skin lesions, and higher mortality rates. This vulnerability is exacerbated in regions where access to antiretroviral therapy (ART) is limited or inconsistent. For example, in sub-Saharan Africa, where HIV prevalence remains high, co-infection with Mpox has been associated with worse clinical outcomes. The immunosuppressive effects of untreated HIV compromise the body's ability to mount an effective immune response to Mpox, leading to more severe disease manifestations. Furthermore, the stigma associated with both HIV and Mpox can deter individuals from seeking timely medical care, further complicating disease management and control efforts. Addressing this dual burden requires integrated approaches that strengthen HIV care services while simultaneously enhancing Mpox surveillance, diagnosis, and treatment capabilities.

The challenges of managing Mpox are magnified in LMICs. Many regions lack sufficient diagnostic infrastructure, with polymerase chain reaction (PCR) testing—the gold standard for Mpox diagnosis—available only in a limited number of centralized laboratories (12,13). Even when testing facilities exist, shortages of trained personnel and reagents often delay early detection and containment efforts. Access to healthcare is similarly constrained by geographic isolation, high out-of-pocket costs, and overwhelmed health systems that struggle to meet demand during outbreaks. These systemic issues are compounded by sociocultural barriers such as stigma, misinformation, and vaccine hesitancy, which discourage reporting and prevention efforts (13–16).

The situation is further worsened by humanitarian crises. Conflict-affected regions and displaced populations are particularly vulnerable to Mpox outbreaks, as overcrowded shelters, inadequate sanitation, and malnutrition create ideal conditions for the virus to spread. Immunocompromised individuals, including those living with HIV, are at heightened risk of severe disease in these settings (17).

Despite these challenges, Mpox is both preventable and manageable with appropriate interventions. Vaccines such as the Modified Vaccinia Ankara (MVA) vaccine have demonstrated effectiveness in reducing transmission, but access to these vaccines remains inequitable, particularly in LMICs. Early case detection, reliable diagnostics, and targeted vaccination campaigns are critical to controlling the disease. Integrating Mpox management into

routine health services, engaging communities to address stigma and misinformation, and ensuring equitable vaccine distribution are essential components of a comprehensive response (18–20).

This manuscript examines the critical barriers to Mpox management in low-resource settings and proposes evidence-based strategies to address these challenges. By tackling diagnostic, healthcare, sociocultural, and crisis-related barriers, the proposed approach aims to reduce the burden of Mpox in vulnerable populations and strengthen health system resilience against future outbreaks.

CHALLENGES IN LOW-RESOURCE SETTINGS

Effective management of mpox in low-resource settings is hindered by several interrelated challenges. These barriers range from diagnostic and healthcare access issues to sociocultural obstacles and the broader impact of humanitarian crises. Each of these factors exacerbates the disease's burden and highlights the urgent need for context-specific interventions.

DIAGNOSTIC CONSTRAINTS

Limited Laboratory Infrastructure

Accurate and timely diagnosis of Mpox relies on polymerase chain reaction (PCR) testing, which remains the gold standard. However, many low-resource settings lack the necessary laboratory infrastructure to perform PCR. For example, in the Democratic Republic of Congo (DRC), only a handful of centralized laboratories are equipped for mpox testing, leading to significant delays in case confirmation during outbreaks.

Even where laboratories exist, frequent power outages, reagent shortages, and poorly maintained equipment significantly limit their functionality. These constraints result in delays in confirming cases, which hampers timely public health responses (20–23).

Shortage of Skilled Personnel

The scarcity of trained laboratory technicians and clinicians familiar with Mpox diagnosis further compounds diagnostic challenges. Attrition of healthcare workers, coupled with insufficient investment in training programs, has left many facilities ill-prepared to handle outbreaks. The lack of expertise delays accurate detection and leads to missed opportunities for early containment (21,22).

Resource Scarcity

Even when diagnostic kits are available, supply chain disruptions often cause delays in delivering essential reagents and materials. These challenges are particularly acute in conflict zones and remote areas, where logistical barriers exacerbate the problem. Prolonged turnaround times for test results can undermine confidence in diagnostic systems and hinder timely case management (21–24).

HEALTHCARE ACCESS CONSTRAINTS

Geographic Inaccessibility

Many remote and rural communities lack access to healthcare facilities capable of diagnosing or treating Mpox. In these areas, long travel distances and poor transportation infrastructure make accessing care a logistical challenge. Some communities may be located hours or even days away from the nearest diagnostic or treatment centers, leading to delays in care-seeking behaviour (24,25).

Overburdened Health Systems

The healthcare systems in many low-resource settings are chronically underfunded and overstretched. Limited hospital beds, inadequate isolation wards, and shortages of personal protective equipment (PPE) leave facilities unable to manage surges in Mpox cases during outbreaks. These systemic deficiencies not only compromise patient care but also put healthcare workers at increased risk of infection (24,25).

Economic Barriers

Out-of-pocket healthcare costs remain a significant obstacle for many individuals in low-income settings. Direct expenses, such as diagnostic fees and treatment costs, combined with indirect costs, such as transportation and lost wages, deter many from seeking care. These economic barriers disproportionately affect the most vulnerable populations, perpetuating cycles of underdiagnosis and delayed treatment (26).

SOCIOCULTURAL BARRIERS

Stigma and Discrimination

The visible lesions associated with Mpox often lead to stigma and social ostracism. In many communities, individuals with suspected Mpox may avoid seeking care for fear of discrimination, which delays case reporting and impedes contact tracing efforts. Such stigma not only exacerbates disease spread but also poses psychological burdens on affected individuals (20,27).

Misinformation

These narratives not only breed fear but also diminish trust in healthcare systems, which are often perceived as inaccessible or unresponsive. In many LMICs, health messaging is inconsistently delivered and frequently overshadowed by rumours spread through informal networks, including social media and word of mouth(28). This undermines the adoption of critical preventive measures such as isolation, contact tracing, and vaccination campaigns.

Vaccine Hesitancy

In low- and middle-income countries (LMICs), vaccine hesitancy remains a significant challenge to effective Mpox outbreak control. Rooted in longstanding mistrust of healthcare systems and governments, this hesitancy is often exacerbated by perceptions of inequity in vaccine distribution. The limited availability of vaccines, coupled with concerns about transparency and fairness, has deepened skepticism. For many in LMICs, Mpox vaccines are perceived as being reserved for wealthier nations or privileged groups, further undermining confidence in vaccination programs.

Despite these challenges, substantial efforts have been made to improve vaccine access in LMICs. Several countries and organizations have donated Mpox vaccines and resources to support African countries heavily impacted by outbreaks. The European Union (EU) has contributed a combined 566,500 doses through the Health Emergency Preparedness and Response Authority (HERA) and Team Europe, alongside €20 million in funding for the Africa CDC-WHO Mpox Continental Preparation and Response Plan. Similarly, the United States donated 1 million doses of Bavarian Nordic's vaccine and $500 million in financial support, delivering 10,000 doses to Nigeria and 50,000 to the Democratic Republic of Congo (DRC). Gavi, the Vaccine Alliance, secured 500,000 doses through its First Response Fund, while UNICEF procured an additional 500,000 doses. Japan has also made significant contributions, donating 3 million doses of the LC16 vaccine(29–31). Despite these contributions, challenges persist in vaccine deployment. Logistical issues, such as inadequate cold chain infrastructure and difficult terrain, continue to delay vaccine delivery to remote and underserved regions. For instance, while the DRC has received over 200,000 doses, operational delays and legal barriers have hindered the vaccination of vulnerable populations, including children. Similar logistical constraints have been reported in other LMICs, where poor transportation networks and limited storage facilities further complicate distribution efforts (32).

IMPACT OF HUMANITARIAN CRISES

Humanitarian crises, including armed conflicts, natural disasters, and forced displacement, significantly exacerbate the challenges of managing Mpox in low-resource settings. These crises disrupt healthcare systems, weaken public health infrastructure, and create conditions that facilitate the spread and severity of the disease.

Conflict and Displacement

Populations affected by conflict or displacement are often forced into overcrowded shelters or camps where basic needs, such as clean water, sanitation, and healthcare, are unmet. These environments significantly increase the risk of Mpox transmission through close contact, poor hygiene, and inadequate isolation measures. Displaced individuals frequently face barriers to accessing healthcare, with limited availability of diagnostic services, vaccines, and treatment options. For example, internally displaced persons (IDPs) and refugees in endemic regions such as the Democratic Republic of Congo (DRC) have encountered systemic neglect during Mpox outbreaks, with minimal resources allocated to disease prevention and management efforts (33,34).

Immunocompromised Populations

Crisis-affected populations often have a higher prevalence of malnutrition, HIV co-infection, and other immunocompromising conditions, all of which increase susceptibility to severe Mpox outcomes. In conflict zones, disruptions in antiretroviral therapy (ART) exacerbate the vulnerability of individuals living with HIV, leaving them at heightened risk for complications. Similarly, food insecurity driven by conflict or displacement weakens immune responses, further amplifying the burden of Mpox in these populations (17,20).

Cross-Border Spread

High population mobility during humanitarian crises, particularly among refugees and IDPs, increases the likelihood of Mpox spreading across borders. Such transboundary outbreaks strain already fragile healthcare systems in neighboring countries and complicate containment efforts. Coordinated regional responses are critical but are frequently undermined by political instability, weak surveillance systems, and logistical challenges, leaving significant gaps in outbreak management (20,35,36).

Structural and Operational Challenges

Healthcare systems in crisis zones are often overwhelmed, with facilities destroyed, staff displaced, and resources diverted to address immediate emergency needs. These disruptions severely limit the capacity for surveillance, testing, and vaccination. For instance, in the DRC, logistical and legal barriers delayed the rollout of Mpox vaccines to vulnerable groups despite the receipt of substantial vaccine donations.

Similar challenges are reported across other conflict-affected regions in Africa, where infrastructure limitations hinder the timely delivery of diagnostic tools, vaccines, and personal protective equipment (PPE).

STRATEGIES FOR MPOX MANAGEMENT

To overcome the barriers highlighted in the challenges section, a comprehensive approach is essential. This involves strengthening diagnostics, improving healthcare access, promoting community engagement, and expanding vaccination coverage. These strategies address specific gaps in low-resource settings and provide actionable solutions to mitigate mpox's impact.

STRENGTHENING DIAGNOSTIC CAPACITY

Point-of-Care Testing

Addressing the lack of laboratory infrastructure requires innovative diagnostic solutions. Rapid, low-cost diagnostic tools, including isothermal amplification methods such as LAMP, enable accurate and timely mpox detection in resource-limited settings. These tools reduce reliance on centralized laboratories and mitigate delays caused by logistical and supply chain disruptions (37).

Mobile Laboratories

To bridge geographic and infrastructure gaps, mobile diagnostic units equipped with PCR capabilities can be deployed to hard-to-reach areas. These laboratories reduce diagnostic turnaround times and ensure timely confirmation of cases, especially during outbreaks in remote or conflict-affected regions (37,38).

Workforce Development

Training programs for laboratory technicians, nurses, and community health workers are essential to address the shortage of skilled personnel. Such programs can empower local healthcare workers to identify and manage Mpox cases effectively, reducing diagnostic delays and improving outbreak response.

ENHANCING HEALTHCARE ACCESS

Task-Shifting and Task-Sharing

Geographic inaccessibility and overburdened health systems can be alleviated by training community health workers to handle mild Mpox cases and support public health efforts. Task shifting ensures that limited healthcare resources are optimized while extending care to underserved populations (39).

Integrated Service Delivery

Integrating mpox management into existing healthcare programs, such as maternal health, immunization services, and HIV care, improves resource utilization and reduces fragmentation of services. This approach also helps reduce stigma, as patients seeking care for other conditions can receive mpox services discreetly. For example, integrating mpox screening and vaccination into routine HIV care visits can enhance early detection and prevention efforts.

Many individuals living with HIV already access healthcare services regularly for antiretroviral therapy (ART) and viral load monitoring, providing a unique opportunity to deliver Mpox-related interventions. Co-locating mpox services within HIV clinics can streamline care, reduce duplication of efforts, and improve patient outcomes. Additionally, healthcare providers trained in both HIV and Mpox management can offer more comprehensive care, addressing the unique needs of immunocompromised patients who are at higher risk of severe Mpox disease. This integrated approach not only optimizes resource use but also strengthens health systems by fostering collaboration across disease-specific programs.

Infrastructure Investment

The lack of isolation facilities and reliable power supply in many LMICs can be addressed by collaborating with international organizations to upgrade infrastructure. For example, constructing isolation units and deploying solar-powered electricity systems in rural healthcare facilities can significantly improve outbreak readiness.

PROMOTING COMMUNITY ENGAGEMENT

Public Education Campaigns

Addressing misinformation and stigma requires culturally tailored public education campaigns. By disseminating accurate information about Mpox transmission, symptoms, and prevention, these campaigns encourage early reporting, reduce fear, and increase participation in vaccination programs(20). Countries like Ghana and Nigeria have successfully implemented such campaigns during outbreaks (4,40).

Community-Based Surveillance

Empowering community leaders to identify and report suspected cases fosters timely interventions. Local surveillance systems, coupled with digital tools for case reporting, enhance the ability to detect and respond to outbreaks early, particularly in remote areas (20).

Behavioural Change Interventions

Promoting safe hygiene practices, proper isolation of infected individuals, and community-based burial protocols during outbreaks can significantly reduce transmission. These interventions, tailored to local cultural contexts, have proven effective during past Mpox and Ebola outbreaks (20).

Table 1: Table: Challenges, Strategies, and Cited Outcomes

Challenge Category	Example/Outcome	Source
Diagnostic Constraints	Nigeria: Mobile labs reduced diagnostic delays during outbreaks.	Schmidt-Sane et al., 2024 (Infrastructural repair work in Nigeria; (8))
Healthcare Access Barriers	DRC: Logistical/legal barriers delayed vaccine rollout to children.	Reuters, 2024 (DRC vaccine challenges; (32))
Sociocultural Obstacles	Nigeria: Stigma deterred care-seeking; youth-led campaigns improved awareness.	Think Global Health, 2024 (Nigeria's youth initiatives; (4))
Humanitarian Crises	DRC: Overcrowded IDP camps increased Mpox exposure risks.	World Vision International, 2024 (DRC IDP report; (34))
Vaccine Inequity	Nigeria: 10,000 vaccine doses delivered in 2023.	Africa CDC, 2024 (Nigeria's vaccination rollout; (40))
Diagnostic Innovations	East Africa: Mobile labs enabled rapid Mpox surveillance in 2024.	Gehre et al., 2024 (Regional mobile lab deployment; (38))

EXPANDING VACCINATION COVERAGE

Equitable Vaccine Distribution

To address the scarcity of vaccines and inequities in access, global efforts should prioritize high-risk groups, such as healthcare workers and immunocompromised individuals, in endemic regions. Partnerships like the Access and Allocation Mechanism have distributed over 899,000 doses to nine African countries, demonstrating the potential of collaborative vaccine strategies (29–31).

Innovative Cold Chain Solutions

Logistical barriers in vaccine storage and transportation can be overcome through solar-powered refrigeration systems and controlled temperature chain (CTC) technologies. These innovations ensure vaccine potency in remote and rural areas without reliable electricity (19,41).

Partnerships for Vaccine Affordability

Collaborations with organizations such as Gavi, UNICEF, and WHO can reduce vaccine costs and improve supply chain reliability. For instance, the U.S. donation of 1 million doses and Japan's contribution of 3 million LC16 vaccine doses have significantly boosted vaccination efforts in LMICs (29,30).

CONCLUSION

Mpox presents multifaceted challenges in low-resource settings, amplified by inadequate diagnostic capacity, limited healthcare access, sociocultural barriers, and humanitarian crises. An effective response demands a comprehensive framework that integrates advancements in laboratory diagnostics, holistic health system strengthening, targeted community engagement, and equitable vaccine distribution. By prioritizing collaborative efforts among governments, international agencies, and local stakeholders, the global health community can mitigate mpox's adverse impacts and bolster preparedness for future outbreaks.

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