PERSPECTIVE

Monkeypox's Multisectoral Challenge: Why One Health is the key?

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Abstract

The global emergence of mpox (Monkeypox), a zoonotic disease attributed to the monkeypox virus (MPXV), presents a considerable public health dilemma, particularly in the context of the ongoing ramifications of the COVID-19 pandemic. This pathogen, which originated in Central and West Africa and was first documented in human cases in 1970, has proliferated internationally, with the outbreak in 2022 prompting the World Health Organization (WHO) to classify it as a Public Health Emergency of International Concern. The epidemiological profile of mpox indicates notable variations in its distribution, with elevated incidence rates particularly observed among male demographics, notably within the gay, bisexual, and other men who have sex with men (MSM) communities. The primary mode of transmission is through direct exposure to infected biological fluids, lesions, or mucous membranes, while environmental reservoirs and potential vertical transmission are considered to play a lesser role. Populations deemed vulnerable, including those with immunocompromised states and individuals situated in socioeconomically disadvantaged environments, experience increased susceptibility. Clinical features, such as lymphadenopathy, serve to distinguish mpox from smallpox. Diagnostic techniques, including polymerase chain reaction (PCR) and advanced deep learning models, provide high levels of accuracy, although rapid antigen testing remains inconsistent in reliability. Current therapeutic interventions encompass tecovirimat, cidofovir, and brincidofovir, with tecovirimat demonstrating the most substantial efficacy. Severe cases necessitating hospitalization may arise due to complications such as proctitis, secondary infections, or conditions like encephalitis. Adopting a One Health framework, which amalgamates human, animal, and environmental health considerations, is imperative for the timely detection, surveillance, and management of prospective outbreaks. Collaborative initiatives and technological advancements, such as Geographic Information Systems (GIS), are crucial in refining response strategies and achieving enduring public health objectives.

Keywords

Zoonotic Disease; One Health; Mpox; WHO

Introduction

The emergence of infectious diseases presents considerable challenges to global public health, as illustrated by the recent experiences associated with the COVID-19 pandemic, instigated by SARS-CoV-2, which has resulted in an excess of 5.7 million fatalities since its onset in late 2019.(1) In the aftermath of this unparalleled global health crisis, the international community is now faced with an additional health threat: mpox (Monkeypox), a disease that has attracted attention due to its potential ramifications for populations on a global scale.

The mpox outbreak of 2022 was designated as a Public Health Emergency of International Concern, underscoring the imperative for vigilance regarding endemic diseases that have the capacity to transform into global threats.(2) Mpox is classified as a viral zoonotic disease attributed to the monkeypox virus. The monkeypox virus is classified within the Orthopoxvirus genus. Its primary endemic regions are Central and West Africa. The mpox virus (MPXV), initially discovered in 1958 in a cohort of monkeys, was later documented to infect humans in 1970 in the Democratic Republic of the Congo, thereby marking the beginning of its recognition as a zoonotic pathogen.(3) As of 1 January 2022, through all six WHO regions, a total of 126 Member States reported cases of mpox to the World Health Organization (WHO). As of 31 October 2024, the cumulative count of laboratory-confirmed cases stands at 115,101, accompanied by 2 probable cases and a tragic total of 255 fatalities reported to WHO.(4)

EPIDEMIOLOGY

Global distribution and recent outbreaks

The global dissemination and distribution patterns of the Mpox virus, scientifically designated as MPXV, reveal a pronounced heterogeneity across various geographical regions, which is primarily shaped and influenced by both historical patterns of endemicity and the dynamics of recent transmission events that have unfolded over time. Initially recognized as an endemic pathogen predominantly localized to Central Africa, where it has had a particularly severe impact on pediatric populations, Mpox has undergone a notable transformation marked by a shift towards increased human-to-human transmission, resulting in significant outbreaks that have been documented in non-endemic territories, including various countries in Europe and North America, particularly since the year 2022.(5) The World Health Organization (WHO) has officially classified the clade IIb outbreak of this virus as a global health emergency, especially noteworthy due to a marked resurgence of cases in the Democratic Republic of the Congo, where the reported incidence of infections surged dramatically by 160% by the year 2024.(6) Disparities in the distribution of reported cases are distinctly observable, with a notably higher incidence rate among male populations, especially those identifying as gay, bisexual, and other men who engage in sexual activities with other men (MSM) within the United States, thereby underscoring the imperative need for the implementation of targeted public health interventions that are specifically designed to address the unique challenges faced by these communities.(7) Furthermore, it is of paramount importance that continuous genomic surveillance is rigorously implemented and maintained to thoroughly monitor and analyze the intricate evolution of the virus, as well as the complex transmission patterns that accompany it, especially in light of the fact that the ongoing outbreak has been unequivocally associated with multiple sub-clades that exist within the broader clade IIb lineage, which has been documented in previous research.(8)

Modes of transmission

The propagation of the monkeypox virus, predominantly transpires through the intimate and direct interaction with the biological fluids of an infected individual, the lesions present on their skin, or the mucosal membranes, which serve as potential transmission sites for this pathogen. Direct contact with infected individuals for extended periods has been identified as the most critical vector for the transmission process.(9) The outbreak of 2022 underscored the significance of sexual transmission, especially among men who engage in sexual activities with men (MSM), where intimate contact during sexual encounters facilitated the viral spread. Furthermore, the isolation of viable virus from frequently touched surfaces indicates the possibility of environmental transmission.(10) Although vertical transmission from mother to child is not the primary mechanism, it may play a role in the persistence of the virus within isolated communities.(11)

Risk Factor and vulnerable population

The foremost risk factors that significantly contribute to both the transmission dynamics and the severity of mpox within populations that are deemed vulnerable encompass a range of socioeconomic adversities, the presence of immunosuppression, and certain specific social behaviors that can exacerbate the situation. Individuals who have survived the traumatic experience of sex trafficking find themselves in a particularly precarious position, primarily because they often encounter substantial barriers to accessing necessary healthcare services, are frequently exposed to various forms of violence, and are sometimes subjected to coerced sexual encounters, all of which considerably elevate their risk of contracting infections and complicate the implementation of essential public health measures such as contact tracing and vaccination campaigns.(12) In geographical locations such as Zanzibar, individuals who are living with HIV (PLHIV) are confronted with significantly elevated risks that arise from their immunocompromised status coupled with various socioeconomic hardships, factors that collectively intensify their susceptibility to mpox.(13) A comprehensive systematic review and meta-analysis have further substantiated the assertion that individuals who are HIV-positive experience a markedly increased likelihood of being hospitalized upon contracting mpox, thereby highlighting the critical necessity for the establishment of integrated healthcare approaches and the enhancement of surveillance mechanisms within populations that exhibit a high prevalence of HIV infection.(14) Within the African continent, there are additional risk factors that compound the situation, including direct contact with bushmeat or rodents and the absence of smallpox vaccination, with particular emphasis on the fact that young children and individuals who are immunocompromised are especially vulnerable to the adverse effects of mpox.(15)

The contemporary population deemed susceptible predominantly consists of individuals who have not received vaccination against the vaccinia virus, constituting approximately 80%–96% of the overall population. While those that have been immunized do have a degree of immunity to MPXV, this immunity does wane over time so they fall open to infection. In the past, immunization against smallpox (vaccinia) has proven 85% effective in immunizing against MPXV, while the case fatality rate for unprotected exposures to vaccinia is said to be 9.8%.(16)

Mpox and mental health

Mpox exerts a profound influence not only the psychological well-being and mental health of individual persons but also extends its effects to the collective well-being and mental states of entire communities, thereby highlighting the intricate relationship between public health issues and the psychological responses of both isolated individuals and social groups, with particularly adverse effects on vulnerable demographics such as LGBTQ+ individuals. The stigma surrounding mpox, intensified by online homophobic sentiments, contributes to elevated levels of anxiety and social isolation among gay, bisexual, and other men who have sex with men (GBMSM).(17) This outbreak has illuminated pre-existing health disparities, whereby marginalized populations experience heightened psychological distress and encounter significant barriers to accessing healthcare.(18) Moreover, the anxiety surrounding potential infection, coupled with the social ramifications associated with mpox, has prompted behavioural modifications, including a reduction in sexual interactions, which, although effective in limiting transmission, may also result in increased feelings of loneliness and depression.(19) Collectively, the dynamics of stigma, health inequities, and adaptive behaviours accentuate the pressing necessity for focused mental health interventions and community support mechanisms to alleviate the psychological ramifications of mpox.(20)

Clinical Manifestation

Notably, the clinical manifestation of lymphadenopathy serves as a critical distinguishing feature that serves to differentiate the disease known as mpox from the more historically prevalent disease referred to as smallpox, which is characteristically devoid of this early manifestation involving the swelling of lymph nodes, a finding that has been documented in various studies.(21,22) The development of the rash in mpox initiates prominently on the facial region and subsequently disseminates to various other anatomical locations throughout the body; in contrast, the lesions associated with smallpox exhibit a more uniform distribution across the dermal layers.(23) Furthermore, the disease mpox is generally correlated with a presentation of milder clinical symptoms and a significantly reduced mortality rate when juxtaposed with smallpox, which has been historically recognized for its elevated fatality rates in afflicted populations.(22,24) While it is true that both diseases exhibit certain overlapping characteristics, the conspicuous presence of lymphadenopathy, coupled with the comparatively milder clinical trajectory observed in cases of mpox, represents pivotal differentiating factors that are essential for accurate diagnosis and understanding of these related viral infections.(21,23)

Diagnosis

The most efficacious diagnostic methodologies that have been developed and utilized for the accurate identification of mpox cases encompass both polymerase chain reaction (PCR) techniques and the increasingly prevalent applications of deep learning methodologies, both of which have been demonstrated to exhibit remarkably high levels of sensitivity and specificity in clinical settings. PCR technology is widely acknowledged within the scientific community for its robust reliability when it comes to confirming the presence of mpox infections in affected individuals; however, it is important to note that this method may encounter significant operational challenges, particularly in resource-constrained environments where there is a scarcity of specialized laboratory facilities necessary for its implementation.(25,26) Conversely, advanced deep learning models, exemplified by the architecture known as ResNet50v2, have illustrated an extraordinary degree of accuracy, achieving a remarkable classification rate of 99.33% when tasked with the identification of mpox lesions derived from photographic images, yet these models also face considerable difficulties when it comes to distinguishing mpox from other visually analogous diseases, such as chickenpox, which can lead to diagnostic confusion.(27) Rapid antigen detection tests (AgRDTs), although they have undergone thorough evaluation in various clinical studies, have been found to demonstrate a concerningly low sensitivity rate, with figures plummeting as low as 10.53%, thus rendering them unsuitable and not recommended for clinical use in practice.(28) The limitations inherent in these diagnostic methodologies are multifaceted, encompassing issues such as the propensity for cross-reactivity in serological testing protocols and the pressing necessity for enhancements in sensitivity levels within rapid testing frameworks.(26,29)

Treatment and Management

Antiviral treatments

Current therapeutic modalities available for the management of mpox predominantly encompass agents such as tecovirimat, cidofovir, brincidofovir, and vaccinia immune globulin, wherein tecovirimat has emerged as the most rigorously examined and widely implemented option within this pharmacological catalogue. Tecovirimat has demonstrated notable efficacy in various animal models, and its administration has been correlated with a comparatively favorable safety profile observed in several human cohorts; however, it is important to note that recent randomized controlled trials, including the PALM 007 study, have revealed that there is no statistically significant difference in the rate of lesion resolution when tecovirimat is compared to a placebo control group.(30,31) Moreover, a number of observational studies have put forth evidence suggesting that the timely administration of tecovirimat might lead to an enhancement in the resolution of symptoms as well as a reduction in the rates of hospitalization among affected patients.(31) On the other hand, cidofovir and brincidofovir have been utilized with less frequency in clinical practice, primarily attributable to the concerning adverse event profiles associated with their use in therapeutic settings.(30)

Hospitalization criteria and monitoring

The criteria for hospitalization in cases of mpox, which is an infectious disease caused by the monkeypox virus, are primarily centered around the identification and management of severe clinical manifestations and complications that significantly differentiate this condition from a multitude of other dermatological disorders that may present with similar cutaneous symptoms. It is important to recognize that hospitalization becomes a necessary intervention for patients who are suffering from intense and debilitating pain, particularly when that pain is a result of proctitis, as well as in cases where secondary bacterial infections or serious complications such as encephalitis arise, with various studies indicating a substantial proportion, approximately 13%, of individuals diagnosed with mpox requiring hospitalization specifically due to these critical factors.(32,33) Furthermore, it is noteworthy that patients who are also living with HIV, those who exhibit severe forms of proctitis, and individuals presenting with elevated levels of lactate dehydrogenase are identified as being at an increased risk of necessitating hospitalization.(34) The clinical manifestations associated with mpox infection have the potential to closely resemble those seen in other dermatological conditions; however, the unique complications associated with mpox, in addition to the necessity for targeted antiviral therapies such as tecovirimat, serve to underscore the distinctive criteria that govern the requirement for hospitalization in affected patients.(32,35)

Conclusion

In order to successfully tackle the complex challenges posed by mpox, along with various other zoonotic diseases that have significant implications for public health, while simultaneously striving to fulfill the objectives outlined in Sustainable Development Goal 3, which aims to ensure the promotion of healthy lives and the enhancement of well-being for individuals across the entire spectrum of age groups, it is absolutely crucial that we adopt and implement a comprehensive One Health approach; this multifaceted strategy necessitates the integration of considerations pertaining to human health, animal health, and the health of our shared environment into a cohesive framework that addresses these interrelated aspects of health in a holistic manner. This multidisciplinary framework is conducive to early detection and surveillance, which are critical components for managing outbreaks such as mpox, particularly given the observed increase in incidence since 2022.(36) Ongoing surveillance of both human and animal populations is essential, as emerging zoonotic diseases frequently originate from animal reservoirs, with approximately 60% of newly identified infectious diseases attributed to them.(37) Collaborative initiatives among health sectors, environmental organizations, and relevant stakeholders enhance the sharing of data and communication, thereby facilitating a rapid response to emerging threats.(38) Furthermore, the establishment of systematic zoonotic surveillance and the application of technological tools, such as Geographic Information Systems (GIS), can significantly enhance disease tracking and intervention strategies.(39) In summary, a One Health approach not only addresses immediate health challenges but also fosters sustainable practices aimed at mitigating future zoonotic risks.(40)

Authors Contribution

All authors have contributed equally.

Declaration of Generative AI and AI Assisted Technologies in the writing Process

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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