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Review Article

Monkeypox and human metapneumovirus in India: addressing preparedness and challenges amid emerging threats

Aditi Verma[1]*, Anjum Ara[2]

[1]Department of Public Health Dentistry, Faculty of Dentistry Jamia Millia Islamia, New Delhi, India
[2]Department of Pathology, Faculty of Dentistry Jamia Millia Islamia, New Delhi, India

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***Correspondence:**
Dr. Aditi Verma,
E-mail: averma1@jmi.ac.in

ABSTRACT

The advent of monkeypox (Mpox) and the human metapneumovirus (hMPV), along with serious public health consequences, emphasizes the global vulnerability to these diseases that were earlier endemic in other countries. India's high population density poses unique disease management and prevention challenges against such infections. However, India still has the advantage of having a huge healthcare workforce. Medical practitioners in primary health care services are ideally positioned to screen and intervene early to contain such diseases and reduce these viral outbreaks. Since the typical Mpox rash is extensive and involves the oral cavity and perioral structures frequently, accompanied by cervical lymphadenopathy, dentists could also play a major role by routinely embedding an efficient screening of Mpox cases into dental health services and providing timely referrals to appropriate authorities and help in the containment of the disease. While the respiratory system is the primary target of the hMPV, the secondary effects or the systemic nature of these viral infections may result in some indirect consequences in the oral cavity. The recent increasing spread of Mpox and hMPV into non-endemic countries has raised questions regarding global readiness and response measures to combat these infections in India. Hence, this paper examines India's current strategies including the healthcare infrastructure, surveillance systems, public health policies, the role of medical and oral healthcare workers, challenges, and recommendations for strengthening preparedness against Mpox and hMPV, drawing on global best practices.

Keywords: Challenges, Human Metapneumovirus, India, Monkey Pox, Preparedness, Viral threats

INTRODUCTION

The world is nearing another public health emergency in the form of new viral threats such as Mpox, often called Mpox, and hMPV. The recent viral infections pose another serious threat when the world has started recovering after combating the COVID-19 pandemic. The Mpox virus belongs to the family *Poxviridae* and genus *orthopoxvirus* and the hMPV belongs to the *Paramyxoviridae* family and the genus *pneumovirus* both are a viral illness.[1-3]

Human Mpox cases were initially documented in 1970 in the Democratic Republic of the Congo, and outbreaks have subsequently been reported in several African countries and non-endemic locations.[1,4,5] This disease spreads through contact with contaminated bodily fluids, lesions, and close contact and is characterized by fever, lymphadenopathy, and a pustular rash similar to smallpox.[1,2]

hMPV was initially discovered in 2001 and is now recognized as a major cause of acute respiratory illnesses. It has clinical similarities with respiratory syncytial virus (RSV), which frequently causes bronchiolitis and pneumonia. In India, where ARI is a major public health concern, the presence of hMPV increases the demand for healthcare resources.[6]

Thus, these recent viral infections highlight the need for countries, including India, to strengthen their epidemiological response capabilities. India's vulnerability to Mpox and hMPV originates from characteristics like high population density, diverse ecosystems permissive to zoonotic spillovers, and densely populated metropolitan and underserved areas that could increase disease transmission in our country.[7] Effective epidemiological tracking is critical for India in reducing the spread of Mpox and hMPV, necessitating a strong surveillance and diagnostic infrastructure.

EPIDEMIOLOGY OF MPOX AND HMPV

Around the world

The world health organization (WHO) in mid-August 2024, proclaimed that Mpox cases are on the rise in various African countries and declared it a public health emergency of international concern (PHEIC). This declaration underlined the issue's urgency and demands more global collaboration to combat the outbreak. The two genetic clades of Mpox have been isolated: the West Africa (WA, clade II) and the Congo Basin (CB, clade I) the latter is also known as the Central African (CA) clade with severe infection.[8] In 1970, a 9-month-old boy in the Democratic Republic of the Congo (DRC) who had suspected smallpox contracted the first human infection from the Mpox virus.[1,9] Between January 2022 and July 2024, WHO reported 1,03,048 Mpox cases and 229 fatalities in 121 countries. Out of these, 3,900 confirmed disease cases were reported in 15 African nations as of September 2024. The three nations with the highest number of cases in 2024 are Nigeria, Burundi, and the Democratic Republic of the Congo.[10]

The hMPV has been isolated from people of all ages and on every continent when it was initially discovered.[6] According to seroprevalence tests, samples taken in 1958 had hMPV antibodies, indicating that the virus had been circulating for at least 50 years. Although a seasonal distribution has been well documented, hMPV infections are seen all year round. The epidemiological peak of hMPV occurs in temperate regions between December and February, and it frequently falls within or follows the period of high hRSV activity.[3,6] But the abnormal rise in respiratory virus transmission recently in China, specifically hMPV, has drawn attention from around the world, with some suggesting that hospitals are overburdened in China, according to data released for the period ending December 29, 2024.[11,12]

In India

Since WHO's 2022 PHEIC declaration, 32 Mpox cases have been reported in India as of September 24, 2024.[1,10] The first instance in India was recorded on July 15, 2022, in Kerala with a history of overseas travel. The first locally transmitted case was reported in Delhi on July 24, 2022. The most recent instance of Mpox was reported on March 27, 2024.[13] India has also reported the first case of the aggressive Clade 1b strain of Mpox. This strain is regarded as more hazardous than earlier strains reported in India and has been related to epidemics in the Congo.

The first instance of hMPV in India was recorded on an eight-month-old boy who was found to be positive for hMPV airways in a Bengaluru hospital on January 2, 2025.[14] This respiratory virus affects the lungs. As of January 8, 2025, 7 hMPV cases have been reported in India.[14] Thus, India is aggressively implementing preventative measures and taking appropriate actions to address potential threats of an increase in these viral cases.

SIMILARITIES AND DIFFERENCES BETWEEN Mpox AND hMPV

hMPV nd Mpox virus (formerly known as monkeypox virus) have certain characteristics, but they differ greatly in terms of their biology, mode of transmission, and clinical manifestations. An outline of the similarities and differences is provided below:

Similarities

Viral pathogens: Both viruses can infect people and cause systemic or respiratory diseases.

Zoonotic origins: The Mpox virus is a zoonotic virus, which means that it mainly starts in animals but can spread to people.[1,2] The origin of hMPV can be traced to similar family ties in birds and other non-human species, even though it is not zoonotic.[6,12]

Transmission through contact: Close contact with contaminated objects or infected people can spread Mpox.[1,4,5] Although respiratory droplets are the main way that hMPV is propagated, contact with contaminated surfaces can also spread this virus.[3,2,12]

Prevention is key: Preventing both entails using masks, washing your hands frequently, and avoiding contact with infected people.[4,5,11,12]

Global health concern: International health organizations have identified these viruses as significant infectious agents that need to be watched closely.

Differences[1,4,5,11,12]

The Mpox virus and hMPV are both human-pathogenic viruses and have some similarities in terms of how they spread, they differ greatly in terms of their primary routes of infection, clinical manifestations, and genetic makeup. While hMPV is a respiratory virus that causes infections including bronchiolitis and pneumonia, especially in young and immunocompromised individuals, Mpox predominantly causes systemic disease with a distinctive rash.

Table 1: Differential features of Mpox and hMPV.

Feature	Mpox virus	hMPV
Family	*Poxviridae*	*Paramyxoviridae*
Genome	DNA virus	RNA virus
Endemic regions	Central and West Africa primarily	Global
Symptoms	Rash, fever, lymphadenopathy, muscle aches	Respiratory symptoms (cough, wheezing), fever
Primary target	Systemic (skin, lymph nodes)	Respiratory tract
Transmission	Close contact with lesions, body fluids	Respiratory droplets, close contact
Primary hosts	Humans, rodents, primates	Humans
Vaccination	Vaccines exist (smallpox vaccine for Mpox)	No specific vaccine for hMPV

Compared to Mpox and hMPV, COVID-19 spreads quickly and over various channels. Mpox and hMPV, however, can still result in limited epidemics and present public health issues, particularly in susceptible groups. Hence, the best course of action suggested to reduce the risk of transmission of these infections is the same as for the COVID-19 global pandemic which is early diagnosis and social separation from people who are infected or have been exposed.[15] Secondly, community intervention to reduce the spread of any viral outbreaks can be beneficial.[16]

INDIA'S HEALTHCARE INFRASTRUCTURE

India's healthcare system consists of both public and private services and has major challenges in terms of quality and accessibility especially in rural areas. Examining India's existing healthcare infrastructure and response capacities is necessary to gauge its readiness for Mpox and hMPV:

Early screening

As the country responds to the potential spread of these infections, healthcare workers across various specialties including medical practitioners, dental practitioners, nurses, and public health officials, contribute to containing the outbreak and supporting affected patients. Medical personnel, particularly those in primary care settings and specialty clinics, must be vigilant while diagnosing Mpox and hMPV. The shared symptoms of Mpox and hMPV are fever, fatigue, headache, and sometimes respiratory signs that are relatively nonspecific and may be common to other viral infections. Both the disease frequently begins with flu-like symptoms. However, the hallmark features of each disease are distinctive rash for Mpox and respiratory distress for hMPV making it easier to distinguish between them clinically. Early diagnosis of these diseases is critical in preventing further transmission. Clinicians must consider Mpox and hMPV in the differential diagnosis of patients reporting fever, followed by rash or respiratory distress, especially from locations where outbreaks have been documented or in those who have recently traveled to endemic countries.[4] Mpox can produce lesions in the mouth and throat, which are useful diagnostic indicators. Oral Healthcare professionals are ideally positioned to detect these lesions early. Ulcers, pustules, and vesicles are among the possible oral symptoms.[10] However, specific signs or symptoms directly affecting the oral cavity are uncommon with hMPV infections. If oral symptoms do occur, they are typically indirect effects of the respiratory infection rather than direct manifestations of the virus in the oral cavity.[5] Recognizing these symptoms by dentists can lead to early disease detection, allowing for faster referral to healthcare providers for appropriate testing and treatment.[10,14]

Surveillance system

The integrated disease surveillance program (IDSP) in India has been developed to monitor and report such outbreaks in real time.[10,14,17] IDSP regularly monitors ARI trends, but specific data on hMPV are scarce. There is a need to enhance the IDSP's capacity to detect and track Mpox and hMPV-specific cases. The response efficiency can be increased by incorporating digital health solutions and modernizing data collection techniques.[18]

Testing and confirmation

When Mpox is suspected based on clinical presentation, medical personnel must immediately refer patients for laboratory testing to confirm the diagnosis and provide timely interventions. The Indian council of medical research (ICMR) and the national institute of virology (NIV) because of their past involvement in the eradication of smallpox and COVID-19 are in a good position to test Mpox and hMPV.[10,14,19,20]

Mpox and hMPV can be diagnosed using real-time polymerase chain reaction (PCR) a molecular diagnostic approach that recognizes viral genetic material with excellent sensitivity and specificity.[1,5,11,21,22] This test is similar to the one commonly used to detect SARS-CoV-2 during the COVID-19 epidemic, except it uses virus-specific primers and probes. Multiplex RT-PCR methods can identify numerous diseases at once, including SARS-CoV-2, hMPV, and Mpox.[22] Currently, only 35 laboratories across the country are equipped to test suspected cases of Mpox.[10] Although other techniques like virus isolation, immunohistochemistry, enzyme-linked immunosorbent assay (ELISA), and electron microscopy can also be employed, they undoubtedly call for more complex and advanced equipment as well as specialized facilities, like a suitable level of biosafety for handling viruses.[2,11]

Infrastructure facilities

Having proper isolation centers and quarantine measures in place is critical for controlling Mpox and hMPV epidemics. India's healthcare system still faces issues such as a lack of ICU beds, poor paediatric facilities, and unequal distribution of healthcare between rural and urban areas. These factors may impede the successful control of such epidemics. The adoption of current COVID-19 facilities as a model can help to rapidly scale isolation procedures if the need arises.[10,14]

POLICIES AND RESPONSE MECHANISMS

During the COVID-19 pandemic, India has demonstrated its ability to quickly adapt and implement policies amid medical emergencies. These methods consist of:

Public health education: Public awareness campaigns must educate communities about Mpox and hMPV symptoms, transmission, and preventative strategies.[10,14] Both digital and traditional media platforms ought to be used for educational outreach.

Vaccination strategies: India has the advantage of having a smallpox vaccine. Research suggests that it can provide cross-protection against Mpox. Smallpox vaccines should be strategically stocked and possibly deployed, particularly for high-risk groups and frontline healthcare workers.[5,13] While globally, research on hMPV vaccinations is in its early phases. India does not have an hMPV-specific vaccine, and antiviral therapies are also not widely available.[11]

Collaboration with international bodies: Working with international organizations such as the WHO is critical for upgrading response procedures and harmonizing with global best practices for management of such viral diseases.

CHALLENGES AND LIMITATIONS

Even if India's public health system has advanced, there are still several obstacles to overcome:

Resource allocation

One obstacle is the unequal allocation of healthcare resources, especially in underserved and rural areas. To close the healthcare gap between rural and urban areas, appropriate interventions are required by establishing facilities for institutional isolation as well as diagnostic labs and referral networks in rural locations and district hospitals.

Awareness and training

Low awareness regarding diagnosis and referral for Mpox and hMPV among healthcare providers and the general public can cause delays in their containment. Thus, healthcare workers across various specialties including medical practitioners, dental practitioners, nurses, and public health officials need specialized training programs that concentrate on such viral illnesses and can improve the capacity for diagnosis and treatment.

Community engagement

Health initiatives may be hampered by public mistrust and false information. Building trust and promoting adherence to preventive measures through mass media campaigns and community-based programs are essential.

RECOMMENDATIONS

The following actions are advised to improve Mpox and hMPV readiness:

Strengthening surveillance

Healthcare professionals' knowledge and education in both public and private healthcare facilities. Even frontline healthcare professionals, such as accredited social health activists, can assist with detection, prompt reporting, and enabling the right referral. Using technologies like AI-driven analytics for predictive insights, the IDSP could be improved to incorporate particular protocols for Mpox and hMPV monitoring.[23]

Capacity building

Enhancing the public and private health care systems to better plan for and respond in case of Mpox and hMPV outbreaks if required. Even, though Indian laboratories are ready with diagnostic facilities for Mpox and hMPV, just as they were for COVID-19; the already existing ones can be utilized to diagnose Mpox and hMPV cases also. It is necessary to set up referral links to transport samples to the specified Mpox and hMPV laboratories.[23] These diagnostic facilities should be expanded to district-level hospitals also. This will ensure the appropriate diagnostic coverage and speedier response along with the expansion of existing laboratory networks. The priority should be to train the healthcare personnel in all locations in India and they should collaborate with laboratories to guarantee efficient sample collection and testing.

Strategic stockpiling

Keeping vital antiviral drugs and smallpox vaccines in strategic stockpiles will lessen the effects of future outbreaks. Also, monitoring the Mpox virus's genome is important because it is said to be changing quickly. Currently, there is no particular antiviral medication for HMPV and no vaccine to prevent it. Symptomatic treatment remains the predominant technique.[11] There is a need to invest in hMPV vaccine research and development. Also, the research related to epidemiology and genetic diversity of hMPV should be done in India.

Public health programs

Proactive containment will require the implementation of targeted campaigns to educate the communities about Mpox and hMPV symptoms, transmission, and preventative measures. There is also a need to collaborate with schools and workplaces to promote respiratory hygiene for the prevention of hMPV and to safeguard the most vulnerable population of children.

CONCLUSION

India needs to respond to possible Mpox and hMPV outbreaks in a variety of ways, including improved surveillance, updated policies, preparedness in the laboratories, and community involvement. The nation's resilience against Mpox, hMPV, and other viral risks can be strengthened by filling up identified gaps through strategic investments and concerted efforts, even though current frameworks offer a foundation for preparedness.

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