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Viewpoints

Monkeypox: A resurfacing threat and global public health challenge in India

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The global monkeypox outbreak presents a significant public health challenge, particularly in India, due to its rapid spread and the complexities of controlling transmission. This commentary discusses the epidemiological trends, transmission dynamics, and the challenges faced in managing the outbreak. Adopting a multidisciplinary approach, it reviews available data and literature on the spread and control of monkeypox, examining current surveillance systems, public health preparedness measures, and strategies employed to contain the disease. The review indicates that while efforts are underway to manage the outbreak, significant gaps remain in global surveillance and preparedness. The lack of targeted vaccination strategies and inconsistent public health responses exacerbate the difficulty of controlling monkeypox. Additionally, notable gaps persist in understanding its full transmission dynamics. The commentary calls for enhanced surveillance systems, improved public health preparedness, and the development of targeted vaccination strategies to mitigate the spread of monkeypox. It also emphasizes the need for a coordinated global response to emerging infectious diseases and proposes a more integrated, multidisciplinary approach to strengthening global health collaborations.

INTRODUCTION

Monkeypox, a zoonotic illness endemic to some regions of Africa, attracted global attention in 2022 due to a multi-country outbreak. The emphasis has predominantly been on high-income countries; nevertheless, the possible public health ramifications for India, a densely populated nation with a multifaceted healthcare system, necessitate thorough examination.[1] This perspective examines the ramifications, emphasizing surveillance, prevention, treatment, and the overarching framework of public health infrastructure. During the COVID-19 pandemic, the abrupt increase in monkeypox cases highlighted the interdependence of global health and the persistent risk of emerging diseases. This perspective explores the urgent public health issues associated with monkeypox and the difficulties in executing effective control strategies in a developing nation.

As of the latest available data, India has reported a number of monkeypox cases, primarily concentrated in certain states. The first confirmed case of monkeypox in India was detected in July 2022, in the state of Kerala. Since then, the number of reported cases has gradually increased, with additional cases being recorded in various regions across the country. The exact number of confirmed cases fluctuates due to ongoing surveillance and reporting. However, major outbreaks have been seen in states like Kerala, Uttar Pradesh, and Delhi. India's health authorities have implemented public health measures to contain the spread, including travel advisories, isolation protocols for suspected and confirmed cases, and public awareness campaigns. In the broader regional context, neighboring countries in Asia, such as Bangladesh, Thailand, and Sri Lanka, have also reported cases, highlighting the potential for cross-border transmission. The current statistics emphasize the need for robust surveillance, effective containment strategies, and regional collaboration to manage the spread of the disease and prevent further outbreaks. India's response continues to evolve with increasing resources being allocated to diagnosis, treatment, and preventive measures, including public health communication and the establishment of monitoring systems to track trends in monkeypox infections.

Monkeypox, once confined to endemic regions in Central and West Africa, gained global attention due to rising cases outside these areas. In 2022, the disease spread to Europe, North America, and Asia, prompting the World Health Organization (WHO) to declare it a public health emergency of international concern in July. This surge in cases led to increased surveillance, preventive measures, and vaccine availability across the globe, with countries like the United States, the United Kingdom, and several European nations reporting outbreaks. The global response emphasized the need for coordinated efforts in managing infectious diseases, including sharing diagnostic tools, treatment protocols, and vaccine research. Vaccines such as JYNNEOS, ini-

tially used for smallpox, have been pivotal in controlling monkeypox. This international collaboration highlights the importance of a multi-sectoral approach to disease control, with lessons learned from the global response serving as a guide for managing emerging diseases, including in India.

Monkeypox is caused by the monkeypox virus (MPXV), which belongs to the Orthopoxvirus genus of the Poxviridae family. The virus primarily transmits to humans through direct contact with infected animals, particularly rodents and non-human primates, or through human-to-human contact via respiratory droplets, bodily fluids, or contaminated materials. Upon infection, the virus enters the body through broken skin, mucous membranes, or respiratory tract and begins to replicate locally in the skin or lymph nodes.

The pathogenesis of monkeypox involves several stages:

1. Incubation Phase: The virus has an incubation period of 5 to 21 days. During this time, individuals are asymptomatic but can begin to experience mild fever, malaise, and fatigue.
2. Early Infection and Lymphadenopathy: After the incubation period, the virus spreads to the lymph nodes, causing significant lymphadenopathy (swelling of lymph nodes), which distinguishes monkeypox from other poxvirus diseases like smallpox.
3. Skin Lesions and Systemic Symptoms: The hallmark of monkeypox infection is the appearance of a characteristic rash, which typically begins on the face and spreads to other parts of the body. The rash evolves through different stages, including macules, papules, vesicles, pustules, and scabs. Fever, headache, and muscle aches accompany the rash, reflecting systemic viral spread.
4. Resolution and Potential Complications: Most cases resolve within 2 to 4 weeks. However, in severe cases, complications such as secondary bacterial infections, pneumonia, and encephalitis may occur, especially in immunocompromised individuals.

The virus's ability to replicate in multiple tissue types and cause lymph node enlargement, along with its zoonotic potential, underscores the complexity of its pathogenesis. Understanding these biological features helps in designing targeted public health strategies for surveillance, prevention, and treatment.

India's response to the 2022 monkeypox outbreak was swift and coordinated across government, healthcare, and public health sectors. Following the first case in July 2022, the Ministry of Health and Family Welfare issued advisories for state health departments to monitor and report suspected cases. Guidelines for case management, contact tracing, and quarantine were rapidly deployed, crucial for containing the spread. Enhanced surveillance efforts included expanding diagnostic testing facilities, with several states setting up PCR testing laboratories. This improved diagnostic capacity enabled prompt identification and isolation of suspected cases, minimizing community transmission. Public awareness campaigns were launched to educate the population about symptoms, transmission, and prevention, while healthcare workers were trained in infection prevention protocols. India also leveraged international partnerships, particularly with the WHO, to acquire vaccines and treatments, ensuring resources were available to prevent further spread. The country's prompt deployment of public health measures, vaccination, and awareness efforts were key to limiting the outbreak's scale, showcasing India's capacity for rapid and effective disease management.

In response to the 2022 monkeypox outbreaks, India implemented a series of strategic measures to control the spread of the disease and protect public health, covering surveillance, diagnosis, public awareness, and healthcare responses.

1. Surveillance and Case Reporting:
   The Ministry of Health and Family Welfare issued guidelines for identifying and reporting suspected cases, ensuring contact tracing and quarantine. A nationwide surveillance system was established to monitor and report potential cases.
2. Diagnostic Capacity and Testing:
   To enhance early detection, additional PCR testing centers were set up across regions. The government also collaborated with private laboratories to increase testing availability, reducing the burden on public facilities.
3. Public Health Guidelines and Protocols:
   Clear case management guidelines, including isolation protocols and clinical care for confirmed cases, were issued to healthcare facilities. Hospitals were equipped with PPE and isolation units, in line with global infection control standards.
4. Vaccination and Preventive Measures:
   Vaccines for high-risk groups, such as healthcare workers and close contacts of confirmed cases, were introduced. India leveraged its vaccine production capabilities and sought international support to obtain vaccines.
5. Public Awareness Campaigns:
   The government launched media campaigns to educate the public about symptoms, transmission, and preventive measures. Public service announcements and health guidelines were distributed through TV, social media, and bulletins to raise awareness and reduce stigma.
6. International Cooperation:
   India worked with international bodies like the WHO to share information and adopt best practices. Regional cooperation with neighboring South Asian countries enhanced collective efforts to control the outbreak.

Despite India's swift response to the 2022 monkeypox outbreak, several challenges emerged, highlighting areas for improvement in future preparedness and response efforts:

1. Limited Awareness and Stigma:
   Despite widespread information campaigns, public confusion and stigma persisted, with many associ-

ating monkeypox with Africa. Misinformation about transmission and symptoms increased fear, hindering timely medical care and further complicating public health efforts.

2. Healthcare System Capacity:
   The healthcare system, though large, was stretched by the volume of cases. Initial deficiencies in isolation facilities, PPE, and trained staff, particularly in rural areas, led to delays in diagnosis and care.
3. Diagnostic Challenges:
   Expanding diagnostic capacity was hindered by limited testing centers in rural areas, delays in diagnosis, and reliance on PCR testing. The absence of specific monkeypox tests in many centers further complicated early identification.
4. Surveillance Gaps:
   Despite strengthened surveillance, real-time data collection and reporting were inconsistent, with underreporting from regional centers. The lack of a centralized database hindered rapid responses to emerging hotspots.
5. Supply Chain Disruptions:
   Global supply chain issues delayed the distribution of PPE and vaccines, and vaccine availability was limited, particularly in rural or underserved areas. This created challenges in ensuring equitable access to critical resources.
6. Intersectoral Coordination:
   Coordination between national, regional, and local authorities, as well as with animal health and community organizations, was insufficient. A more integrated approach, including communication across sectors like healthcare, agriculture, and wildlife management, was needed.
7. Zoonotic Transmission and Prevention:
   Managing zoonotic transmission was complicated by India's diverse ecology and frequent human-animal interactions. Public health efforts lacked a clear strategy for controlling wildlife-related sources of infection, posing challenges in tracing outbreaks.
8. Public Health Infrastructure:
   Disparities in public health infrastructure, especially in rural areas, hindered effective outbreak management. The workforce faced challenges related to understaffing, lack of training, and burnout during peak periods.

The challenges highlighted systemic issues in India's healthcare infrastructure and the complexities of managing zoonotic diseases. To improve future responses, a more integrated approach to surveillance, diagnosis, resource distribution, and public communication is needed. Addressing these barriers will strengthen India's ability to handle not only monkeypox but also other emerging infectious diseases.

SURVEILLANCE, EARLY DETECTION AND RAPID RESPONSE

A robust public health approach to zoonotic diseases like monkeypox requires integrated surveillance, early detection, and rapid response. Effective healthcare training and public awareness campaigns should be supported by clear containment protocols and resource mobilization plans. One of the main challenges in India is ensuring equitable resource distribution between urban and rural areas, particularly in high-risk zones. The government, in partnership with international organizations and local NGOs, should prioritize funding for zoonotic disease prevention.

Engaging local communities through awareness campaigns can address logistical barriers and improve the effectiveness of control measures. Early detection relies on accurate diagnosis, requiring healthcare professionals to differentiate monkeypox from diseases with similar symptoms, such as chickenpox and measles. Enhanced surveillance and training, coupled with a rapid response system, are critical for swift containment, particularly in high-risk regions.

Strengthening surveillance, especially in healthcare facilities, is essential, involving trained personnel, adequate testing, and clear reporting protocols. Genomic surveillance is also key to tracking transmission and identifying variants. A comprehensive approach incorporating international collaboration, expanded case definitions, integrated human-animal surveillance, and real-time data exchange is crucial to monitor the spread of the virus and coordinate responses.[2] Vigilance among healthcare providers, especially in non-endemic areas, is essential, particularly for travelers or those in contact with suspected cases. Comprehensive surveillance of both human and animal populations will help detect spillover events and break transmission chains.[3]

Timely and accessible monkeypox testing is crucial for early case identification, isolation, and contact tracing. Training healthcare professionals to recognize the disease's symptoms and improving public awareness of its transmission and prevention are key to early detection and management.[4] In India, challenges include insufficient emergency preparedness in remote areas, communication delays between local and national authorities, and gaps in contact-tracing infrastructure, particularly in rural regions where healthcare worker density is low. There are disparities in testing resources between urban and rural areas, with cities having better access to diagnostic technologies. In contrast, rural areas suffer from limited testing facilities, leading to delays in diagnosis and underreporting of cases. Inconsistent testing protocols and delays in receiving results further hinder accurate diagnoses and facilitate the spread of the virus. Logistical issues, such as slow sample transportation from rural areas to central labs, exacerbate testing backlogs. The lack of integration between contact tracing and testing infrastructure also delays isolation of suspected cases, contributing to further transmission. By strengthening surveillance systems, improving testing accessibility, and enhancing contact tracing, public health authorities

can better disrupt transmission chains and protect global health security.

A MULTIFACETED APPROACH: PREVENTION AND CONTROL OF MONKEYPOX

Preventing widespread monkeypox transmission requires a comprehensive approach, focusing on public education, contact tracing, isolation of confirmed cases, and the provision of personal protective equipment (PPE). Public awareness campaigns should emphasize symptoms, transmission, and preventive measures to encourage hygiene and minimize close contact. Effective contact tracing and isolation are crucial for interrupting transmission chains. In India, challenges such as limited access to PPE in rural areas, supply chain disruptions, and the high cost of protective gear impede efforts to control the spread of the disease. Public adherence to preventative measures, including mask-wearing and social distancing, is hindered by misinformation, mistrust in health advisories, and traditional beliefs in rural areas. Therefore, public health campaigns must focus on building trust and educating communities on the importance of preventive behaviors. Given the risk of animal-to-human transmission, monitoring animal populations and promoting safe handling practices is essential. A robust public health strategy should integrate individual preventive actions with systematic interventions, such as isolating infected individuals until they are no longer contagious, tracking close contacts, and promoting practices like handwashing, respiratory etiquette, and the use of PPE when handling infected materials.[5]

ADDRESSING ZOONOTIC TRANSMISSION AND ANIMAL SURVEILLANCE

Animal surveillance is a critical component of preventing monkeypox transmission to humans, aligning with the One Health approach that emphasizes the interconnectedness of human, animal, and environmental health. Monitoring wildlife, particularly rodents and primates, as well as domesticated animals, helps detect potential reservoirs and vectors of the virus. Early detection in animals allows for timely interventions, reducing the risk of transmission to humans. In regions with frequent human-animal interactions, comprehensive surveillance systems should be established to monitor animal populations for the monkeypox virus. Educating people who interact with animals—such as hunters, traders, and wildlife handlers—on proper handling protocols and zoonotic transmission risks is essential.[6]In endemic areas, targeted vaccination efforts, including the "ring vaccination" strategy (vaccinating close contacts of confirmed cases), can reduce the spread of the virus. Vaccination should be adapted to available resources and outbreak dynamics, prioritizing high-risk populations, including healthcare workers and individuals with frequent animal contact.India's diverse geography and healthcare infrastructure present logistical challenges to zoonotic transmission control. Rural areas, with limited healthcare and veterinary services, require local health surveillance teams to identify zoonotic diseases early. These teams must be trained to collaborate with public health authorities to contain outbreaks.Integrating human and animal health surveillance is essential. Public health workers and veterinary teams must be aligned to ensure effective communication and rapid response. Regular training and the use of mobile health technologies in remote areas can help bridge gaps in data collection and response times.

PUBLIC HEALTH CONSIDERATIONS

Clear, timely, and accessible communication is crucial in managing monkeypox outbreaks, especially to combat misinformation and stigma. Public health authorities must educate the population on transmission, symptoms, and preventive strategies to foster informed decision-making and alleviate fear associated with the disease. Digital platforms (social media, mobile messaging apps) are essential to engage younger, tech-savvy populations, while traditional media (posters, radio, and television) remain crucial for reaching rural or underserved communities. Platforms like WhatsApp, Facebook, and Twitter can disseminate updates and prevention messages quickly, while television and radio can target broader, non-digital audiences. CHWs are pivotal in delivering culturally appropriate, accurate information and directly engaging local populations, especially in rural areas. Training CHWs to identify potential cases and respond to questions can help mitigate misinformation and increase public trust in health interventions. 'Targeted messaging' with tailored messages to specific cultural, linguistic, and regional contexts is essential to overcome barriers like language differences and low literacy levels. Collaborating with local leaders to shape these messages ensures they resonate with the community and improve engagement. Access to the internet and smartphones is uneven, particularly in rural and economically disadvantaged areas. Efforts must ensure information reaches everyone, including through offline methods like community outreach, printed materials, and local broadcasting. Combating stigma associated with monkeypox is critical. Stigma reduction can encourage individuals to seek testing and treatment without fear of judgment. Community involvement in spreading the message is key to dismantling misconceptions and addressing public reluctance. By integrating digital tools, traditional media, and the active participation of community health workers, India can reach diverse populations and effectively manage outbreaks. However, overcoming logistical barriers—like the digital divide and cultural differences—will be essential to ensure that all communities receive accurate, timely health information.

To manage the monkeypox outbreak effectively, ensuring equal access to diagnosis, treatment, and supportive care for all individuals, regardless of their socioeconomic status or geographic location, is crucial. This approach is particularly important for a country as diverse as India, where disparities in healthcare access exist. It is essential to ensure equal access to medical resources, such as diag-

nostic tools, antiviral treatments, and healthcare professionals, especially for rural and underserved populations. Health disparities in India, such as higher maternal mortality rates in rural areas and difficulties in accessing modern healthcare services for tribal communities, highlight the need for equitable health interventions. Ongoing surveillance of monkeypox cases and treatment outcomes is necessary for refining public health strategies and addressing issues such as antiviral resistance. Surveillance must also extend to health disparities to monitor how different populations are affected and adapt responses accordingly.

Developing new antiviral therapies, vaccines, and diagnostic tools is crucial for enhancing the global response to monkeypox and improving patient care. Research investments will support long-term control and preparedness for future outbreaks. The COVID-19 pandemic has underscored the need for a resilient public health infrastructure that includes improved surge capacity, infection control protocols, and public health communication. The COVID-19 experience also highlighted challenges related to health disparities between urban and rural regions, showing that rural populations face difficulties accessing care due to geographic isolation and underdeveloped healthcare systems. India's digital divide remains a significant barrier, particularly in rural areas, where internet access is limited. As of 2020, only 50% of India's rural population had access to the internet, compared to 80% in urban areas.

This divide hinders the effectiveness of digital health campaigns, which are crucial for timely dissemination of information about prevention, diagnosis, and treatment of monkeypox. Rural and tribal populations often face challenges in accessing government-led healthcare services due to cultural barriers and reliance on traditional healers. Limited internet access in remote areas compounds the issue, as these populations may not receive important health updates through digital platforms like social media or mobile messaging apps. Effective monkeypox control requires a comprehensive approach that addresses health equity, continuous surveillance, research, and digital inclusion. Strengthening healthcare systems in rural areas, ensuring equal access to health resources, and investing in new technologies will help mitigate the impact of monkeypox on vulnerable populations.

SOCIOECONOMIC CONTEXT, VULNERABILITY AND HEALTH EQUITY

The monkeypox outbreak underscores the critical role of socioeconomic factors in determining health outcomes. At-risk populations, such as those living in poverty or with pre-existing health conditions, face disproportionate impacts from infectious diseases like monkeypox. Effective public health responses must prioritize equity to reduce these disparities and ensure access to essential services for all. Deploying mobile health units in remote, underserved areas can provide essential services like vaccination, diagnostics, and consultations. These units can address healthcare access gaps by bringing services directly to rural communities, minimizing the need for long travel distances. Offering subsidized or free testing for high-risk populations, particularly those in poverty or underdeveloped regions, ensures that financial constraints do not prevent timely diagnosis and intervention. Utilizing telemedicine can bridge the gap between rural populations and urban medical professionals, enabling remote consultations, diagnosis, and follow-up care. This technology reduces access barriers, especially in areas with limited healthcare infrastructure. Providing subsidies or free access to personal protective equipment (PPE) and vaccines for economically disadvantaged groups ensures that cost does not hinder protection from monkeypox.

These strategies, when implemented systematically and sustained over time, can help address health inequities and provide adequate protection to all communities, reducing the spread of monkeypox. Ensuring equitable access to healthcare services, particularly for underserved and economically disadvantaged populations, is critical in combating monkeypox. By addressing socio-economic disparities through targeted strategies like mobile health units, subsidized testing, and telemedicine, India can create a more inclusive public health response and help protect vulnerable communities from infectious disease outbreaks.

In public health emergencies like the monkeypox outbreak, certain populations face heightened vulnerabilities due to socioeconomic factors such as poverty, marginalization, and lack of access to healthcare. These groups often have limited access to medical infrastructure, inadequate transportation, and face high healthcare costs, which make them more susceptible to both contracting and spreading infectious diseases. Limited access to healthcare facilities and transportation challenges in rural and tribal areas prevent timely diagnosis and treatment. Mobile health units and telemedicine could bridge these gaps by providing onsite diagnostic services, vaccinations, and consultations. The homeless face significant health risks due to lack of stable housing, sanitation facilities, and healthcare access. Without the infrastructure for proper hygiene or medical care, this group is especially vulnerable to both contracting and spreading infectious diseases like monkeypox. Individuals living in overcrowded urban slums often face inadequate hygiene, poor healthcare infrastructure, and challenges in maintaining social distancing. Overcrowded environments contribute to higher transmission rates and limit access to proper medical care during outbreaks. Tailored outreach programs are necessary to ensure that this group receives proper healthcare and education on preventative measures. Migrant workers, especially seasonal laborers working in high-risk environments, often lack access to timely healthcare during outbreaks.Their mobility and transient living conditions make it difficult to track health status and provide adequate care during an emergency. Mobile health units can provide vaccinations, diagnostics, and consultations in rural, tribal, and marginalized areas.

Offering low-cost or free testing and treatment to marginalized groups, such as the homeless or migrant workers, would improve early detection and help prevent disease spread. Expanding telemedicine services can help rural and underserved populations access remote consultations, min-

imizing the need to travel long distances for medical care. Public health initiatives must actively engage marginalized groups through community health workers and culturally appropriate health messages. This will ensure that groups like sex workers and migrants are not left out of healthcare access and public health interventions. Public health responses to monkeypox must prioritize health equity to ensure that all populations, particularly vulnerable groups, have access to timely and effective care. By focusing on mobile health units, subsidized healthcare, and telemedicine, India can improve healthcare access for marginalized communities and help reduce the spread of monkeypox.

ONE HEALTH APPROACH

The One Health approach is an integrated, cross-sectoral strategy that recognizes the interconnectedness of human, animal, and environmental health. It focuses on the idea that human health is closely linked to the health of animals and ecosystems, making it crucial to implement collaborative surveillance systems to predict and prevent zoonotic diseases like monkeypox. This approach is essential for improving early detection and controlling outbreaks of diseases that have animal reservoirs or vectors. Animal health surveillance plays a critical role in preventing zoonotic diseases like monkeypox from spilling over into human populations. While the exact animal reservoir of monkeypox is still under investigation, rodents are suspected to play a significant role in transmitting the virus. Early detection in animal populations can act as an early warning system for human cases, enabling quicker intervention and preventing widespread transmission. Effective collaboration between public health professionals, veterinarians, wildlife specialists, and environmental scientists is vital to understanding the ecological factors influencing disease transmission. Sustainable land-use policies that limit human intrusion into wildlife habitats can reduce the risk of zoonotic spillover events. Developing data-sharing protocols between human, animal, and environmental health sectors can facilitate real-time information exchange, allowing for early detection of potential outbreaks.Establishing integrated surveillance systems that combine data from these sectors is key to tracking zoonotic diseases, predicting outbreaks, and mitigating risk factors. Joint training programs for healthcare workers and veterinary professionals can ensure a shared understanding of zoonotic diseases like monkeypox.

These programs should include recognizing symptoms, proper reporting, and coordinated action for high-risk areas where human-animal interactions are frequent.

Effective communication between local governments, national health authorities, and animal health experts is crucial for timely interventions and cohesive outbreak response strategies.

The Centers for Disease Control and Prevention (CDC) and the United States Department of Agriculture (USDA) collaborate on a joint One Health initiative. This includes joint research, shared databases, and synchronized surveillance for detecting zoonotic disease outbreaks. The Kenyan government has implemented a One Health approach to combat diseases like Rift Valley Fever and avian influenza, including joint training for human and veterinary health workers, and cross-sectoral coordination for disease surveillance and reporting. The European One Health Action Plan against Antimicrobial Resistance (AMR) coordinates data and policies between human health, animal health, and environmental sectors, helping reduce the spread of antimicrobial resistance through integrated monitoring.

ACTION ITEMS FOR IMPLEMENTING ONE HEALTH IN INDIA

- Facilitate real-time exchange of information across human, animal, and environmental sectors to enable early warning and prompt response to zoonotic outbreaks.
- Implement training initiatives for healthcare and veterinary professionals to develop a shared response protocol for zoonotic diseases, focusing on disease recognition, reporting, and coordinated action.
- Establish combined surveillance systems to monitor both human and animal health, providing a more comprehensive understanding of disease trends and enabling quicker interventions.
- Ensure timely interventions and cohesive strategies by enhancing communication between local governments, national authorities, and animal health experts.

By adopting a One Health approach, India can better tackle zoonotic diseases like monkeypox, improving early detection, control, and prevention efforts while promoting global health security. The integration of human, animal, and environmental health surveillance can be a game-changer in responding to emerging infectious diseases.

CONCLUSIONS

The resurgence of monkeypox in India poses a significant public health challenge, particularly in marginalized and rural areas. Strengthening surveillance systems and improving early detection are crucial to preventing widespread transmission. Expanding diagnostic capacity at local healthcare centers and enhancing healthcare worker training are key to timely case identification. Public awareness campaigns should educate communities about symptoms, testing, and the importance of early medical attention, especially in rural areas where misconceptions about zoonotic diseases are prevalent. The ring vaccination strategy is vital for controlling outbreaks, targeting high-risk contacts to limit spread. Equitable vaccine distribution is necessary to protect vulnerable populations, including tribal communities and the urban poor, who face barriers to healthcare access. The One Health approach, integrating human, animal, and environmental health sectors, is essential for managing zoonotic diseases like monkeypox. Surveillance of animal populations, particularly rodents, will help detect potential human outbreaks early. India should implement national

guidelines for rapid response to emerging infectious diseases, with clear protocols for detection, containment, and vaccination. By improving vaccine access, training healthcare professionals, and fostering partnerships between local, state, and national health authorities, India can build a more resilient public health system capable of tackling both current and future infectious threats

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