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Review Article

Monkeypox (MPOX): Distinguishing Mechanisms, Epidemiology, Exposure Strata, Diagnosis, Diagnostic Tools, and Adverse Effects on the Brain, Eyes, Heart, Lungs, and Skin

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Abstract

Monkeypox (MPOX) infection poses a significant threat to human health, impacting various organ systems with diverse clinical manifestations. This review outlines the adverse effects of MPOX on specific human organs, including the brain, eyes, heart, lungs, and skin. Severe neurological complications, such as encephalitis and seizures, can occur. Ocular complications, more prevalent in unvaccinated individuals, can lead to vision-threatening issues. Early detection and intervention play a crucial role in reducing morbidity and mortality associated with cardiovascular complications such as myocarditis and dilated cardiomyopathy. Severe pulmonary complications include bronchopneumonia and acute respiratory distress syndrome (ARDS). Dermatologic lesions, characteristic of MPOX, entail early diagnosis and collaborative management to avert scarring and secondary bacterial infections. Diagnosis relies on clinical symptoms, particularly the characteristic rash, and a comprehensive clinical history. Despite the absence of specifically approved treatments, prevention strategies, including vaccination and antiviral agents such as brincidofovir, tecovirimat, and cidofovir, show promise in controlling MPOX outbreaks. Vigilant monitoring of cardiovascular parameters and personalized therapeutic interventions are crucial for comprehensive patient care. Research opportunities abound, with a need for a deeper understanding of the systemic and mucosal immune response to MPOX and the development of novel drugs.

Keywords: *Brincidofovir; Cidofovir; Infectious Diseases; Monkeypox; Pandemic; Tecovirimat*

Abbreviations

ACTG: AIDS Clinical Trials Group; ANO: Adenosine N1-Oxide; AUR: Acute Urinary Retention; CAM: Complementary and Alternative Medicine; CDC: Centers for Disease Control and Prevention; CRS: Coding Region Sequences; DdRp: DNA-Dependent RNA Polymerase; DRC: Democratic Republic of the Congo; ECDC: European Centre for Disease Prevention and Control; EFC: Entry Fusion Complex; INRB: Institute for Biomedical Research; IVIG: Intravenous Vaccinia Immune Globulin; ITR: Inverted Terminal Repeat; MPOX: Monkeypox; MPOXROD: MPOX-Related Ophthalmic Disease; MPXV: Monkeypox Virus; NIAID: National Institute of Allergy and Infectious Diseases; ORF: Open Reading Frame; SSHAP: Social Science in Humanitarian Action Platform; STI: Sexually Transmitted Infection; UK: United Kingdom; US FDA: US Food and Drug Administration; WHO: World Health Organization

Introduction

Monkeypox (MPOX), caused by the monkeypox virus (MPXV), has emerged as a rare but increasingly concerning zoonotic disease, marked by the potential for significant epidemics [1]. The clinical manifestations of MPOX closely resemble those of chickenpox, posing challenges in accurate diagnosis and containment [2]. Discovered in 1958 by virologist Preben Christian Alexander von Magnus during investigations into smallpox-like outbreaks among laboratory monkeys, MPOX's origin is traced back to African rodents [3,4]. Recent studies have even suggested the evolution of MPXV predates its formal discovery in Denmark [3].

In the Democratic Republic of the Congo (DRC), the first documented human case of MPOX occurred in 1970 when a 9-month-old child was initially suspected of smallpox [3,4].

Subsequently, an increasing number of MPOX cases were identified, particularly in Central Africa, where Clade I of the virus prevailed and was associated with more severe disease and distinct geographical distribution [5]. Further, Clade II, prevalent in West Africa, exhibits two subclades, IIa and IIb [5,6]. ("A clade, derived from ancient Greek, is a group of organisms that are derived from a common ancestor and its lineal descendants" [7]).

The identification of notable outbreaks in Africa between 1981-1986 and 1996-1997 emphasized higher attack rates and lower case-fatality ratios, highlighting the evolving nature of MPOX [8]. The first reported case outside Africa occurred in the United States in 2003, emphasizing the global reach of the virus [5,6]. The re-emergence of MPOX in Nigeria in 2017 and the severe 2022 outbreak with substantial human-to-human transmission beyond Africa underscore the urgency of understanding and managing the disease [9,10].

Discussion

MPOX overview

Monkeypox (MPOX), a zoonotic disease caused by the orthopoxvirus subfamily of the Poxviridae family, has gained increasing prominence due to its transmission dynamics and global spread [11]. The virus is transmitted from infected animals or humans to humans through various means, including lesions, body fluids, fomites, respiratory droplets, and contaminated materials [12]. The disease is believed to have an animal reservoir comprising squirrels, rats, monkeys, primates, prairie dogs, hedgehogs, pigs, and mice, primarily in regions of Africa where MPOX has historically been prevalent [13]. Figure 1 depicts the nonspecific symptoms and complications of MPOX [14].

Molecular characteristics of MPOX

The MPOX virus' 196,858 base pair double-stranded DNA genome encodes approximately 200 proteins. Recent cryo-electron microscopy studies have provided insight into the structure of the MPOX virus DNA polymerase holoenzyme, revealing its interaction with

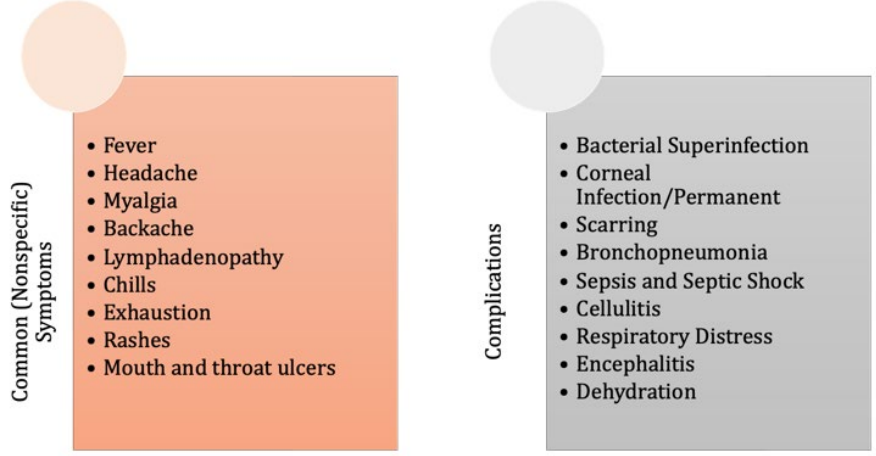

Figure 1: *Symptoms and complications of MPOX [14]*

DNA at a resolution of around 2.8 angstroms [15]. The virus enters human cells through direct interaction between viral coat molecules and cell membrane receptors, with specific viral proteins facilitating attachment and subsequent entry. Once inside the host cell, MPOX replicates in the cytoplasm and can result in primary and secondary viremia, leading to the characteristic febrile illness, lymphadenopathy, and vesicular-pustular rash associated with the disease [16].

MPOX: Epidemiology

In the recent 2022 outbreak, sexual activity has been identified as a significant mode of transmission, primarily through skin and mucosal contact. The European Centre for Disease Prevention and Control (ECDC) has highlighted the potential for MPOX to spread among individuals with multiple sexual partners, emphasizing the importance of understanding and addressing this mode of transmission [9]. Notably, viral loads are elevated in various bodily fluids, including urine, saliva, sperm, and feces, as well as in oropharyngeal and rectal swabs [17,18].

In the United States, specific demographic groups, such as Black or African American individuals from Africa and Hispanic or Latino individuals, represented a significant portion of reported MPOX cases in July 2022. These groups may have increased exposure to infected animals or contaminated materials, emphasizing the need for targeted public health interventions [19,20].

Healthcare workers, particularly those in direct contact with MPOX patients, are also at a higher risk of infection if proper precautions—including identifying MPOX lesions and using personal protective equipment (PPE)—are not followed [21].

While historically predominant in Central and West Africa, MPOX has now spread beyond its endemic regions to countries such as the United States, the United Kingdom, Singapore, Israel, Portugal, Germany, France, Spain, Italy, the Netherlands, Belgium, Sweden, Australia, Canada, Austria, the Canary Islands, and Switzerland [9,22,23]. The global spread of MPOX underscores the need for international collaboration in monitoring and controlling the disease.

In the United States, as of June 2023, there have been 30,468 reported cases and 42 deaths, with the majority of cases occurring among homosexual and bisexual men [24,25]. The Centers for Disease Control and Prevention (CDC) recommends avoiding contact with infected animals or individuals and encourages vaccination for eligible travelers visiting endemic regions [24,25].

Specific populations, such as young children (<15 years), pregnant women, and immunocompromised or elderly individuals in contact with MPOX cases, may face an increased risk of infection [21,26]. The outbreak in 2022 reported that 98 percent of cases were among homosexual, bisexual, and other men who have sex with men, particularly those who meet partners online, through apps, or at social events [26,27]. Additionally, certain MPOX-associated viruses (such as varicella) can be transmitted from pregnant women to their infants. Thus, the diverse affected populations highlight the importance of considering various demographic factors in MPOX transmission [9,18].

MPOX virus exposure strata and possible inimical outcomes

MPOX virus exposure and adverse outcomes in pregnancy, early life, and adults are highlighted below.

In pregnancy

- MPOX can affect pregnant women and their babies by causing immune vulnerability, hormonal imbalances, and placental barrier breakdown [28].
- MPOX can cause severe outcomes such as congenital infection, pregnancy loss, and maternal morbidity and mortality [29].
- MPOX can cause miscarriage, intrauterine demise, preterm birth, and vertical transmission. A case report of a stillborn fetus with MPOX virus DNA confirmed in utero infection [29]—another case report of a premature infant with MPOX rash who died 6 weeks later [30].
- MPOX can cause perinatal infection in newborns—a case report of a newborn with MPOX rash and respiratory failure who required intensive care. The parents also had an MPOX rash and tested positive for the virus. The infection could have occurred before, during, or after birth [31].
- MPOX can cause high rates of perinatal loss and vertical transmission. A systematic review and meta-analysis of four studies found that 39% of pregnancies with MPOX infection resulted in miscarriage, 23% in intrauterine fetal death, 8% in preterm birth, and 62% in vertical transmission. The overall incidence of late fetal and perinatal loss was 77%. Also, it was observed that the risk of fetal loss was higher in the second trimester than in the first trimester [32].
- No data were found on the effects of monkeypox on lower birth weight, pregnancy-induced preeclampsia, hypertension, increased blood pressure, or time to pregnancy. These effects may be related to other factors such as maternal age, nutrition, infections, or chronic conditions.

In early life

Based on previous foreign studies, children aged 0 - 15 years account for 90% of monkeypox cases [33]. Studies have also revealed that children have higher hospitalization and mortality rates than adults, especially those with underlying conditions or secondary infections [34].

- The primary sign of monkeypox in children is a rash that progresses from maculopapular lesions to vesicles, pustules, and scabs. The rash can appear anywhere on the body, but mainly on the chest, face, and genitals.
- Other potential symptoms in children and adolescents include fatigue, headache, difficulty swallowing, coughing (with oropharyngeal lesions), and intraocular lesions. Some signs may only sometimes be present [35,36].
- Anogenital lesions were not observed in children under 12 [37]. In September 2022, there were reported cases of monkeypox in children in the European Union (EU), European Economic Area (EEA) (n=59), Canada (5), the UK (1), and the US (31).
- In Spain, 3 of 4 cases in <4-year-olds were household-acquired, while 13–17-year-olds acquired the infection in a tattoo parlor (*n*=9) or through sexual contact (*n*=3).
- In Brazil, 141 confirmed/probable infections in children aged 0-17 years have been due to increased community infection rates [38].

In adult life

- MPOX can infect adults through direct or sexual contact with infected people or animals. The most affected group is LGBTQ men aged 24-35. Cases outside Africa also occurred more frequently in males and primarily in adults [9,39,40].
- The symptoms of MPOX in adults are usually similar to children's, but they may be milder or more severe depending on the immune status and severity of infection.
- The study by Patel., *et al*. (2022) aimed to describe the clinical features of MPOX infection in adult men who engage in sex with men. The study included 197 patients who had MPOX confirmed by a laboratory test. The study found that the median age of the patients was 38 years, and all of them were men who had sex with men. All patients presented with mucocutaneous lesions, with the most common sites being the genitals (56.3%) and the perianal area (41.6%). Most patients (86.3%) reported experiencing systemic symptoms such as fever, lymphadenopathy, and myalgia. Some patients (61.5%) developed systemic symptoms before the appearance of mucocutaneous lesions, while others (38.5%) experienced them after. Oral lesions were present in 13.7% of patients, and 4.6% showed tonsillar involvement. Out of 195 participants, 35.9% had concomitant HIV infection. Among those screened for sexually transmitted diseases, 31.5% had concurrent infections [41].

MPOX: Adverse effects on specific human organs

Specific organ systems impacted by MPOX infection are listed below.

Brain

MPXV can cause neurological complications, leading to significant brain damage. MPXV-infected monocytes can cross the blood-brain barrier and reach the brain, causing inflammation and damage to the brain parenchyma. Clinical manifestations of the complications include encephalitis, seizure, and rapid neurological deterioration. MPXV-associated encephalitis may also involve the spinal cord [42]. Clinicians must promptly recognize and treat these neurological complications to prevent lasting brain damage. The neurological impact of MPXV remains an emerging concern, and further studies are needed to understand the full spectrum of its adverse effects on the brain.

Eyes

MPXV can cause ocular manifestations, with some cases leading to severe eye complications. These complications include corneal ulceration, keratitis, and vision-threatening ocular infections, which can result in corneal melt and scarring. Ocular complications of MPXV are more frequent in unvaccinated individuals, where up to 74 percent of the individuals can have severe ocular sequelae [43]. While rare, some patients with MPXV have presented with unusual ocular presentations (one percent), such as membranous keratoconjunctivitis with transient corneal hypoesthesia and late symblepharon formation, corneal ulceration/keratitis, corneal melt, and vision-threatening ocular infections [43,44]. A prompt diagnosis and management of MPXV ocular complications are vital to prevent vision loss and severe morbidity. Table 1 (below) outlines MPOX viral infection-associated ocular manifestations, investigations, and treatment [45].

Heart

MPXV can lead to a wide range of cardiovascular complications, including myocarditis, pericarditis, dilated cardiomyopathy, heart failure, arrhythmias, and other cardiac abnormalities, which can result in significant morbidity and mortality. MPXV can alter blood clotting, leading to bleeding disorders or thrombosis. Some MPXV-infected patients may develop cardiac inflammatory complications. Identifying these inflammatory complications may be helpful in the differential diagnosis of myocarditis [46]. The incidence of cardiovascular complications in MPXV is unclear. Further research is needed to determine the range of adverse cardiovascular effects. Early diagnosis and management of cardiac complications in MPXV patients are necessary to prevent added damage and improve patient outcomes.

Lungs

MPXV can adversely affect the lungs, leading to pulmonary complications such as bronchopneumonia, acute respiratory distress syndrome (ARDS), and pulmonary distress, which can be severe and cause significant morbidity and mortality in patients with MPXV. The precise pathogenesis of MPXV pulmonary complications remains unclear. Specific studies are needed to determine the mechanisms underlying these adverse effects and actuate effective treatment and management methods. Bronchopneumonia is a rare but known complication of MPXV infection, and it is vital to consider pulmonary manifestations in patients with MPXV to improve patient outcomes [47].

Skin

MPXV can cause dermatologic lesions, which typically start as macules and evolve into papules, vesicles, pustules, and scabs [48]. These dermatologic lesions are the hallmark of MPXV and can help differentiate it from other febrile diseases. Eczema vaccinatum, a rare and potentially lethal complication of vaccination with vaccinia virus, can occur in individuals with pre-existing eczema and can resemble MPXV lesions [49]. Also, MPXV can lead to secondary bacterial infections such as bacterial cellulitis, which can complicate the management of MPXV and increase morbidity and mortality [50]. Early diagnosis and management of MPXV are vital to prevent scarring and long-term sequelae, and interprofessional management, including dermatologists, is essential in optimizing patient outcomes.

Manifestation	Investigations	Treatment
Blepharoconjunctivitis	Regional- conjunctival swab Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops: 0.5% Moxifloxacin or Gatifloxacin, four to six times a day based on severity. • Antibiotic eye ointment: 1% Azithromycin, applied twice daily. • Hot fomentation to alleviate symptoms. • Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day.
Rash (macular, papular, vesicular, pustular)	Systemic- PCR for MPOX DNA	• Clean the lesion with Mupirocin acid or Fucidin. • Cover the lesion with a dressing. • Systemic antibiotics, such as Fuoroquinolones, for treating secondary infections.
Conjunctivitis	Regional- conjunctival swab Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops: 0.5% Moxifloxacin or Gatifloxacin, four to six times a day based on severity. • Eye ointment- Chloramphenicol + Polymyxin B Sulfate BD
Blepharitis	Systemic- PCR for MPOX DNA	• Antibiotic eye ointment- 1% Azithromycin • Hot fomentation • In severe cases- Azithromycin 500 mg tablet OD for 7 days
Conjunctival ulcer	Regional- conjunctival scraping Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops: 0.5% Moxifloxacin or Gatifloxacin, four to six times a day based on severity. • Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day.
Periorbital edema	Systemic- PCR for MPOX DNA	• Oral anti-inflammatory medication: Tab. Aceclofenac + Paracetamol, taken twice daily for 3-5 days, along with cold compresses.
Preauricular lymphadenopathy	Regional- lymph node biopsy Systemic- PCR for MPOX DNA	• Oral antibiotic- Tab. Azithromycin 500 mg OD for 5-7 days or Cefixime 400 mg BD for 5-7 days. • Oral anti-inflammatory medication: Tab. Aceclofenac + Paracetamol, taken twice daily for 3-5 days, along with cold compresses. • Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day.
Focal lesions	Regional- conjunctival swab Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops- 0.5% Moxifloxacin or Gatifloxacin four to six times based on severity. Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day.
Ulcer (viral, bacterial)	Regional- fluorescein staining, corneal scraping, culture Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops- 0.5% Moxifloxacin or Gatifloxacin four to six times based on severity. Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day and topical Trifluridine four to six times per day
Scar	Systemic- PCR for MPOX DNA	• Consider performing optical keratoplasty after a period of quiescence.
Melt	Regional- fluorescein staining, gentle corneal scraping, culture (if there is an adequate sample) Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops- 0.5% Moxifloxacin or Gatifloxacin one to two hourly, cyanoacrylate glue with BCL
Epithelial defect	Regional- fluorescein staining Systemic- PCR for MPOX DNA	• Topical antibiotic eye drops- 0.5% Moxifloxacin or Gatifloxacin four to six times based on severity. Lubricating eye drops: Carboxymethylcellulose, used six to eight times a day, BCL in case of large defects
BD=Twice daily, OD=Once daily, BCL=bandage contact lens, PCR=polymerase chain reaction		

Table 1: *MPOX viral infection-associated ocular manifestations, investigations, and treatment [45]*

Diagnosis

Human MPOX infection is primarily diagnosed based on clinical symptoms, specifically the characteristic rash. A comprehensive clinical history, including travel to endemic areas, occupational exposure, contact with infected animals, and associated laboratory findings, is essential for distinguishing MPOX from other rash-associated illnesses [51]. Exploring the role of tissue-resident memory T cells and IgA in MPXV infections is highly recommended to comprehend MPOX-related complications better [52]. MPOX's transmission is very different from that of SARS-CoV-2, and doctors may have little experience recognizing and treating it.

Diagnostic tests and tools

Table 2 provides diagnostic aids for MPXV infection detection [12,16].

Diagnostic Tests	Specimen Used	Description
Polymerase chain reaction (PCR)	Lesion exudate/crust sample	The method relies on the nucleic acid amplification test (NAAT) to detect the presence of Mpox DNA (deoxyribonucleic acid). Presently, real-time PCR is considered the most reliable and widely accepted technique for this purpose. This assay is designed to specifically target the viral DNA of monkeypox, ensuring accurate and precise identification. Moreover, the stability of viral DNA is maintained when specimens are stored under dark and cool conditions.
Anti-Orthopoxvirus immunoglobulin G (IgG) and immunoglobulin M (IgM) tests	Blood sample	Examining a recent or historical encounter with *Orthopoxvirus*, including exposure to pathogens like smallpox or assessing the impact of a smallpox vaccination.
Viral culture	Lesion exudate	The virus is cultivated and separated from a specimen obtained from the patient. *Orthopoxviruses* are known to create characteristic "pocks" on chorioallantoic membranes, and alternative cell-based viral culture techniques can also be employed for this purpose.
Electron microscopy	Biopsy, scab lesion, vesicular exudate	The morphology of pox viruses can be used to visually distinguish *Orthopoxviruses* from members of the *Herpesviridae* family.
Immunohistochemistry	Biopsy	The technique employed can demonstrate the presence of antigens specific to *Orthopoxviruses*. This method is valuable for ruling out or identifying other suspected agents, providing a means to differentiate *Orthopoxviruses* from other potential causative agents.

Table 2: *Various diagnostic aids for MPXV infection [12,16]*

MPOX management and prevention

No specifically approved treatments for MPOX currently exist.

- Early detection is crucial for interrupting virus transmission.
- Obtain a complete medical history, including exposure to the virus, activities during infection, protection measures, and high-risk contacts [53].
- Prophylactic interventions in exposed asymptomatic individuals can improve outbreak control.
- Vaccination with smallpox vaccines, brincidofovir, tecovirimat, and cidofovir, has shown effectiveness against MPOX [54].
- Intravenous vaccinia immune globulin (IVIG) may be authorized for use during MPOX outbreaks.
- Resveratrol, an orthopoxvirus inhibitor, has shown efficacy in inhibiting MPOX replication [55].
- JYNNEOS and ACAM2000 vaccinations protect against both smallpox and MPOX.

- LC16, a third-generation vaccine developed in Japan, is effective against smallpox alone [54].
- Comprehensive patient care protocols—for any organ involved—should include vigilant monitoring of cardiovascular parameters, early detection of myocardial involvement, and personalized therapeutic interventions for improved outcomes in MPOX cases.

Several steps can be followed to prevent infection with the MPOX virus, as shown in Figure 2 [53,55].

Avoid contact with animals, particularly sick or dead animals, in areas affected by Mpox virus.
Avoid direct contact with any objects that have been in contact with an infected animal
Separate individuals who are sick with Mpox from those who are at risk of infection.
Practice proper hand hygiene after contact with infected humans or animals
Animal meat should be cooked thoroughly.
Condoms and barrier methods should be used during intercourse. Individuals who test positive for MPXV should be isolated in a separate room and not allowed to leave.
The Advisory Committee and Immunization Practices (ACIP) recommend vaccination for individuals at risk of occupational exposure to poxviruses.
The CDC advises negative pressure rooms for Mpox patients in hospitals, with standard contact and droplet precautions, and airborne precautions if possible.
The Spanish Ministry of Health advises staff to use PPE for contact and airborne precautions: gown, gloves, eye protection and FFP2 masks; FFP3 masks for aerosol procedures. Shoe coverings are not needed, but footwear should be cleanable
Infected patients with active skin lesions should be isolated at home and take precautionary measures to minimize contact with their surroundings and pets. The infected individual should wear a surgical mask and keep the lesions covered until scabs have fallen off and new skin has formed.
Close contacts should be monitored for 21 days, with daily temperature checks. As transmission primarily occurs during symptomatic periods, close contacts do not need to isolate themselves while asymptomatic.
Infected animals should be quarantined for at least six weeks.

Figure 2: *Prevention steps for MPOX virus [53,55]*

Novel drugs

Noteworthy drug molecules under investigation are illustrated in Figure 3 [56,57].

Name	MOA	Status
Mitoxantrone	DNA ligase	In silico studies
CMX-001 Modified cidofovir compound	Inhibits DNA polymerase	Phase II/III trials 2
C-ca3-Ado Antiviral	SAH HYDROLASE INHIBITOR	In vivo studies
C3-Npc A Antiviral	SAH HYDROLASE INHIBITOR	In vivo studies
HPMA Antiviral	DNA polymerase inhibitor	In vivo studies
ANO (Adenosine N1 oxide) Antiviral	Blocks the translation of viral mRNAs	In vivo studies
Rifampin	Viral capsid protein	In silico studies
Ribavirin and ribavirin analogs antiviral	IMP DEHYDROGENASE inhibitor	In vivo efficacy studies
Tiazofurin antiviral	IMP DEHYDROGENASE inhibitor	Not Available

Figure 3: *Potential new drug molecules for MPOX disease [56,57]*

Prospects and research opportunities

Previous global crises or pandemics, such as the outbreak of MPOX in 2022, demonstrate the need for a rapid and comprehensive preventive plan by clinicians, laboratory scientists, epidemiologists, and health decision-makers in all nations [56].

Regarding MPOX, numerous scientific questions still need to be answered. Current research on the systemic and mucosal immune response to MPOX infection in humans is limited, emphasizing the need for additional research to improve the understanding of immune defenses against MPOX [58]. Currently, much of the information regarding the disease originates from isolated case reports, sporadic outbreaks, or intermittent passive surveillance. Further investigation and analysis are required to build upon this limited base of research [59]. Therefore, numerous investigation pathways are available for established and early-career researchers.

Conclusion

The Monkeypox (MPOX) virus, with its extensive DNA genome, has emerged globally, surpassing historical endemic regions. Recent microscopy advances have unveiled details of the virus's interaction with host DNA. The 2022 outbreak highlighted sexual activity as a key transmission mode, emphasizing the need for targeted interventions. Specific demographic groups, including Black or African American and Hispanic or Latino individuals, face elevated infection risks. Healthcare workers, especially those in direct patient contact, are at higher risk, stressing the importance of precautions and protective equipment. The international spread of MPOX emphasizes the need for global collaboration in disease control. In the United States, cases in June 2023 were mainly among homosexual and bisexual men, requiring heightened prevention efforts in this community. Pregnant women, children, and immunocompromised individuals face distinct risks, with adverse outcomes ranging from congenital infections to perinatal loss. MPOX impacts various organ systems, necessitating early detection and intervention for optimal patient outcomes. Neurological, ocular, cardiovascular, pulmonary, and dermatologic complications underscore the virus's diverse clinical manifestations. Despite the absence of specific treatments, promising prevention strategies include vaccination and antiviral agents. Ongoing research opportunities are crucial for a deeper understanding of the immune response and developing novel therapeutic interventions. Vigilant monitoring of patients and personalized care remain crucial in addressing the challenges posed by MPOX. A comprehensive and collaborative approach is vital in managing this evolving public health threat, with prospects for innovative drugs and research opportunities leading the way for future advancements.

Conflict of Interest Statement

The authors declare that this paper was written without any commercial or financial relationship that could be construed as a potential conflict of interest.

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