

# Emergence of Monkeypox Raises a Serious Challenge to Public Health

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**Abstract** Monkeypox is an emerging and re-emerging viral zoonotic disease caused by the *Monkeypox virus*, which is considered the most important *Orthopoxvirus* infection since smallpox eradication. Although most cases are documented in Central and West Africa, there have been sporadic cases reported all across the world, sometimes involving travelers. Outside of Africa, the current outbreak is the largest ever. Close personal contact is how *Monkeypox virus* spreads. The most prevalent routes of infection for humans include respiratory, percutaneous, and permucosal exposures to infected monkeys, zoo animals, prairie dogs, and people. Flu-like symptoms (fever, fatigue, and muscular aches), swollen lymph nodes, and a rash are all commonly observed in monkeypox. The rash can develop anywhere on the body, including the face, genitals, palms, and soles of the feet. The prognosis of the disease in immunocompromised patients is poor. The techniques for the diagnosis of the disease include laboratory culture, polymerase chain reaction (PCR), immunohistochemistry, and electron microscopy. Antiviral drugs such as tecovirimat, cidofovir, and brincidofovir, which are used to treat smallpox, can also be used for monkeypox. Ring vaccination, or targeted smallpox immunization for close contacts of an infected individual, can be used to reduce monkeypox. JYNNEOS is a non-replicating smallpox and monkeypox vaccination that is newer and safer. Other monkeypox vaccines, such as VAC6 and LC16.20, are in the development stage.

**Keywords:** *emerging and re-emerging, Monkeypox, Monkeypox virus, public health, worldwide, Zoonosis*

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## 1. Introduction

The connection of human and animal health is not a novel concept. The extent, scale, and global impact of today's zoonoses, on the other hand, have never been seen before [1]. Since their discovery in the late twentieth century, emerging and re-emerging zoonotic diseases have posed a serious threat to public health around the world. Various factors are thought to be linked to an increase in emerging/re-emerging diseases, which can be summarized as three major global changes: (1) changes in human/society/behavior, (2) changes in environment/ecosystem, and (3) changes in microorganisms [2].

The impact of emerging and re-emerging zoonotic diseases on socioeconomic and public health levels has been substantial, and it poses a significant future problem [3]. Zoonoses are a two-edged sword: one, they cause serious and fatal infections in humans, and the other, they wreak havoc on animal health and productivity [4]. Furthermore, zoonotic diseases are the leading cause of

infectious disorders. It is impossible to say when or where the next novel zoonotic infection will appear, or what its eventual significance will be. Continuous surveillance, research, and training, as well as improved diagnostic facilities and a renovated and well-equipped public health system, are all necessary for their control [5].

Several viral zoonoses have developed from various parts of the world in recent decades, attracting the attention of public health authorities [4,6]. Monkeypox is a zoonotic disease with public health implications that is emerging and re-emerging [7]. Monkeypox was initially identified in 1958, when two outbreaks of a pox-like disease were discovered in monkey study colonies, earning it the name "monkeypox" [8]. Human monkeypox was detected in people for the first time in 1970 in the Democratic Republic of Congo. Since then, the Congo Basin and Western Africa have seen the majority of occurrences. In the spring of 2003, monkeypox cases were confirmed in the Midwest of the United States, marking the disease's first documented occurrence outside of Africa [9]. The major purpose of this review is to delineate the emerging role of monkeypox as a zoonotic pathogen of global public health concern.

## 2. Etiology

Monkeypox is caused by monkeypox virus, which is a DNA virus with double strands that belongs to the *Orthopoxvirus* genus in the *Poxviridae* family. Variola virus (which causes smallpox), vaccinia virus (used in the smallpox vaccine), and cowpox viruses are all members of the *Orthopoxvirus* genus [8]. The monkeypox virus has been divided into two genetic clades: West African and Congo Basin (Central African). The West African clade is typically associated with milder clinical presentation and a case fatality ratio of 0-6%, whereas the Congo Basin (Central African) clade has historically been associated with higher human-to-human transmission and morbidity, with a case fatality ratio of 8-13% [9,10]. The virus is enveloped and slightly pleomorphic, with a dumbbell-shaped core and lateral bodies, with a diameter of 140-260 nm and a length of 220-450 nm. It's resistant to phenolic disinfectants, and it's inactivated by polar lipophilic solvents like chloroform and low pH [11].

## 3. Transmission

The natural reservoir of monkeypox has yet to be discovered. African rodents and non-human primates (such as monkeys) may, nevertheless, carry the virus and infect humans [8]. Many animals in Africa have been reported to be infected with monkeypox virus, including rope squirrels, tree squirrels, Gambian poached rats, dormice, various monkey species, and others [12]. Monkeypox virus is transmitted to humans in endemic areas through a bite or direct contact with the blood, meat, body fluids, or cutaneous/mucosal lesions of an infected animal [13]. Monkeypox transmission from human to human, including nosocomial and household transmission, is widely documented. Human-to-human transmission networks, on the other hand, have been less well recognized [14,15]. The virus is thought to enter the body through broken skin, the respiratory tract, or mucous membranes (eyes, nose, or mouth), presumably via large respiratory droplets or direct or indirect contact with body fluids, lesion material, and contaminated surfaces or other materials, such as clothing or linens. Hospital personnel and family members are more susceptible to infection as a result of prolonged contact with patients [16,17].

## 4. Epidemiology

Two outbreaks of a pox-like disease in colonies of monkeys kept for research led to the discovery of monkeypox in 1958, hence the term "monkeypox." During a period of increased effort to eradicate smallpox, the first human case of monkeypox was discovered in the Democratic Republic of Congo in 1970. Human cases of monkeypox have been documented in several Central and Western African nations since then [18]. Living in densely forested and rural parts of central and western Africa, handling and cooking bush meat, caring for someone infected with monkeypox virus, and not being vaccinated against smallpox are all risk factors for monkeypox infection [19,20]. The United Kingdom reported 9 cases of monkeypox in early May 2022, with the first case recently traveling to Nigeria [21]. The Massachusetts Department of Public Health confirmed a case of monkeypox in an adult male who had just visited Canada on May 18, 2022 [22]. Each of the six US states had at least one incidence of monkeypox and has also been confirmed outside of Africa in 15 European countries, six Asian countries, Australia, the United States, and Canada as of May 26, 2022 [23,24]. These nations have reported a total of 219 confirmed cases [13].

## 5. Clinical Spectrum

The incubation period for monkeypox can range from 5-21 days but usually takes between 7-14 days. In the prodromal or preeruptive stage; the symptoms include fever (typically 38.5-40.5°C), malaise, headache, myalgia, anorexia, prostration, pharyngitis, shortness of breath, cough (with or without sputum), and lymphadenopathy (swollen lymph nodes). Monkeypox differs from smallpox in that it causes lymphadenopathy. Lymph nodes in the neck (submandibular and cervical), armpits (axillary), and groin (inguinal) might swell on both sides of the body or only one. Following these signs, lesions in the mouth and on the body will form in the exanthem (eruptive) stage (Figure 1). Before dropping off, lesions go through numerous stages. Enanthem, macules, papules, vesicles, pustules, and scabs are the phases. After the scabs have gone off, pitted scars and/or regions of lighter or darker skin may remain. A person is no longer contagious once all scabs have gone off [18,25].



Figure 1. Monkeypox lesions in humans. Source: CDC [18]

## 6. Diagnosis

Presumptive diagnoses are frequently made based on clinical presentation and disease progression [9]. Other rash disorders, such as chickenpox, measles, bacterial skin infections, scabies, syphilis, and medication-related allergies, must be considered in the clinical differential diagnosis. Monkeypox can be distinguished from chickenpox or smallpox by lymphadenopathy during the prodromal stage of the disease. Because of its accuracy and sensitivity, the polymerase chain reaction (PCR) is the preferred laboratory test. The skin lesions- the roof or fluid from vesicles and pustules, as well as dry crusts - provide the best diagnostic samples for monkeypox. Biopsy is a possibility when it is possible. Antigen and antibody detection methods do not offer monkeypox-specific confirmation because orthopoxviruses are serologically cross-reactive. When resources are scarce, serology and antigen detection procedures are not suggested for diagnosis or case investigation [12]. In addition to PCR, viral isolation from a clinical specimen, electron microscopy, and immunohistochemistry are additional appropriate procedures to confirm the infection [26].

## 7. Treatment

Monkeypox disease currently has no specific clinically proven treatments. The treatment for most viral diseases is supportive, including antipyretics, fluid balance, and oxygenation [27]. The condition is usually self-limiting, with a resolution time of 2-4 weeks. The mortality rate in African cases ranged from 1 to 10%, and death was linked to the patients' health and other comorbidities. The European Medicines Agency (EMA) approved tecovirimat, an antiviral drug developed for smallpox, for monkeypox in 2022 based on findings from animal and human research. It isn't yet widely available yet [12]. Under an IND or EUA, the FDA-approved antivirals cidofovir and brincidofovir could be used to treat monkeypox, albeit there is inadequate data on their effectiveness in humans. Animal studies, on the other hand, have shown that it is beneficial against monkeypox in certain mammalian species [28]. Vaccinia immune globulin (VIG) is another possible treatment for monkeypox. However, there has been no human testing of VIG for monkeypox or smallpox, and no data on its efficiency against either virus [29].

## 8. Control and Prevention

In the age of globalization, people move around a lot, which increases the risk of monkeypox spreading. The spread of infection is also a serious concern when animals are transported across borders. Biological warfare and the threat of bioterrorism cannot be ruled out, thus a greater understanding of the *monkeypox virus* and other comparable germs could help with emergency management [30]. The main prevention strategy for monkeypox is to raise public knowledge of risk factors and educate individuals about the steps they may take to decrease their exposure to the virus [12]. To avoid

infection with the *monkeypox virus*, take the following precautions: avoid coming into contact with animals that may be infected with the virus (including sick or dead animals found in areas where monkeypox occurs), avoid touching any objects that have come into contact with a sick animal, such as bedding, isolate infected patients from those who might become infected, and wash your hands after coming into contact with infected animals or humans [8]. The infected person should be kept in isolation, wear a surgical mask, and keep lesions covered as much as reasonably possible until all lesion crusts have naturally fallen off and a new skin layer has formed [26]. A bulwark against a disastrous outbreak is the ability of an interdisciplinary team of physicians, nurses, virologists, veterinarians, and public health experts to quickly identify monkeypox infection in humans and animals, apply protective measures, and begin public health reporting [27].

JYNNEOSTM (also known as Imvamune or Imvanex) and ACAM2000® are the two licensed smallpox vaccinations. JYNNEOSTM is also approved for the treatment of monkeypox. According to data from Africa, the JYNNEOSTM vaccine is at least 85% effective in preventing monkeypox. In addition, the JYNNEOSTM vaccine is being explored as a possible post-exposure prophylaxis to reduce disease development and severity. The Aventis Pasteur Smallpox Vaccine is the third smallpox vaccine (APSV). It is a vaccinia virus vaccine with replication competence that could be utilized under an IND or emergency use permission (EUA). If the licensed vaccines for smallpox are unavailable or contraindicated, this vaccine would be used instead. It's unknown whether or not this vaccination could be utilized to prevent monkeypox [31]. Other vaccines for monkeypox are in developmental stage, including VACΔ6 and LC16.20 [29].

## 9. Conclusion

Monkeypox is a contagious viral disease that spreads from animals to humans. The disease has been reported from several countries of the world affecting many people. Fever, rash, and swollen lymph nodes are the most common symptoms of disease. Monkeypox is not just seen in endemic areas anymore. As a result, the monkeypox is a severe emerging disease that has spread throughout the world. Monkeypox infection presently has no effective or safe treatment. The FDA has authorized JYNNEOS, a new smallpox vaccine, for the prevention of both monkeypox and smallpox. To prevent the spread of disease, it is recommended that one should wash the hands properly after handling the sick animals or infected biological materials.

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## Contribution of Authors

All the authors contributed equally as they read the final version, and approved it for publication.

## Conflict of Interest

No conflict of interest among the authors.

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