

# A Review on Monkey Pox: Role of One Health Approach Against Monkey Pox

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## Abstract

The Ortho-poxvirus virus, which causes monkey pox, is a member of the Poxviridae genus. It was initially found in primates. In 1970, the Democratic Republic of the Congo reported the first instance of monkey pox. From there, it spread to a number of countries both inside and outside of Africa. There are two genetic varieties of monkey pox, which have been spread to people through respiratory droplets, and touch with objects contaminated by an affected person and consequently is often encountered in work situations. Among the countries with the worst effects are Nigeria and the Democratic Republic of the Congo. Non-human primates, rats, squirrel, and or mice are just a few of the creatures that can become infected by monkey pox. Although the origins of monkey pox infections are unknown, rodents from Africa and non-human primates like monkeys may contain the viruses and infect humans. Monkey pox is more likely to naturally infect rodents. Monkey pox has symptoms and lesions that are difficult to distinguish from smallpox in its clinical manifestations. Fever, chills, migraines, tiredness, tonia, swollen lymph nodes, back pain, and myalgia are some of the clinical symptoms of monkey-pox. A few examples of diagnostic tests include immune-fluorescent antibody assays, enzyme-linked immune-sorbent assays, and real-time polymerase chain reactions. A specialized vaccine that offers complete protection against by them on key-pox virus exists, yet there is no specific therapy for human monkey infection and interaction with the vaccinia virus. Smallpox vaccination can give cross-immunity with partial protection against infection and a reduction in symptom severity. Unfortunately, community health effects in the view of one health approach has not been addressed in vast. Therefore, the objectives of this review paper are to discuss the community health effects of monkey pox and to emphasize the role of one health approach against monkey pox.

## Introduction

The Orthopoxvirus, which causes monkey pox, is a member of the Poxviridae family. This was initially found in monkeys. Monkey pox is a zoonotic disease that transmits among individuals through respiratory droplets, touch with objects

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contaminated by an infected individual, and close communication with the blood, body fluids; or monkey pox lesions of diseased animals. Ineptly cooked meat may also play a role in the spread of monkey pox [1]. Smallpox and monkey pox are strongly related, and both diseases are reportedly protected by the smallpox vaccine. Since its discovery in the Democratic Republic of the Congo in 1970, monkey pox has spread to a number of other countries, both inside and outside of Africa, but is most commonly found in countries in central and western Africa [2, 3].

The first human case of monkey pox outside of Africa was reported by the United States of America, and cases had also been recorded in Israel, the United Kingdom, and Singapore, mostly after 2018 [4]. The monkey pox virus has two genetic variants: the central African or Congo type and the West African type. The geographical separation between the two subtypes is provided by Cameroon [5]. Nigeria and the Democratic Republic of the Congo are the most severely impacted nations.

Numerous species, particularly rodents, squirrels, dormice, and non-human primates, are predisposed to contracting monkey pox [6]. The most likely natural host form on key pox is a rodent. In Africa, it has also been discovered in primates and squirrels. It has been suggested that recent instances of monkey pox infections in Spain may have been caused via sex at raves in Belgium and Spain [7]. Additionally, incidences of monkey pox have been reported in Canada and Australia [8].

The monkey poxvirus plays a critical role in the transmission of infection between domestic and wild animals in the ecosystem as a zoonotic disease that has the potential to transfer to people and have catastrophic health and economic repercussions. Despite its vast expansion, community health effects in the view of one health approach has not been addressed in vast. Reviewing the community health effects of monkey pox and elaborating the role of one health approach against Monkey-pox are the main goals of this review.

## Literature Review

### *Etiology*

The cause of monkey pox is contact with the monkey pox virus, which belongs to the family Poxviridae's genus Orthopoxvirus [4]. The West African and Central African viral clades have indeed been recognized. The viruses from the Congo Basin are more pathogenic [9].

### *Virology*

The orthopoxvirus known as monkey pox had been initially discovered in a colony of sick monkeys in the late 1950s. The virus is related to the variola and vaccinia viruses in its genus. When the monkey pox virus is found in cells, electron microscopy reveals a brick-like virion that looks identical to the virions of variola or vaccinia viruses. Epidemiologic, animal and molecular evidence points to the existence of two separate strains of monkey pox in several geographic locations in Africa [10]. Monkey pox from Western Africa is less virulent than strains recovered from Central Africa and missing a number of genes seen in another virus strain [10, 11].

### *Epidemiology*

#### *Geographical Distributions*

In West and Central Africa, monkey pox is endemic. There was a monkey pox epidemic in the United States in 2003 that affected both people and exotic pets, but there is no proof that the virus spread across

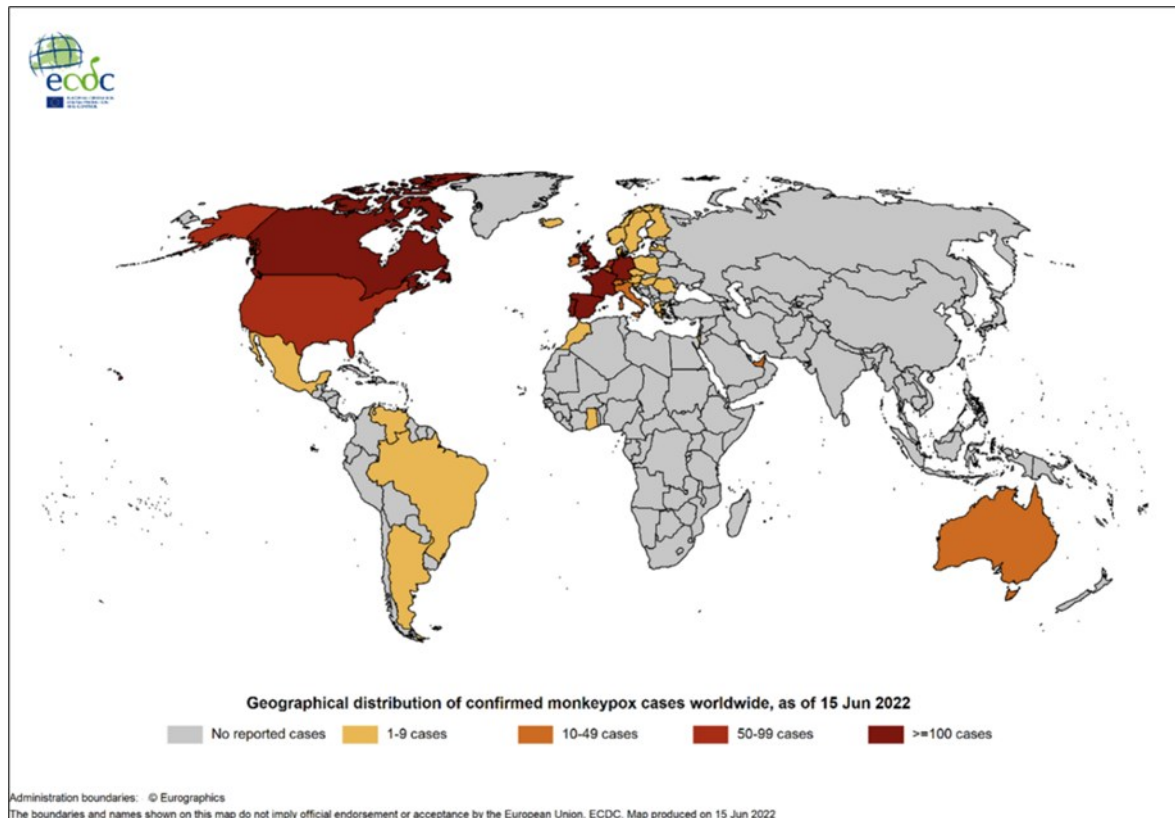


Figure 1. Geographical distribution of confirmed monkey pox cases worldwide, as of 15 Jun. 2022  
source: [13].

North America. Recently, isolated human instances were sent to Singapore, Israel, and the United Kingdom, but the pathogen did not establish itself there [12]. (figure 1)

#### *Sources of infection*

Although the origin of monkey-pox illnesses is uncertain, non-human primates like monkeys and African rats may carry the virus and spread it to humans [14].

#### *Modes of transmission*

This virus is often contracted through a bite or through coming in to contact with an infected animal's bodily fluids. Numerous species of mammals, including ropes quirrels, trees quirrels, Gambian poached rats, dormice, and other species of monkeys, have been reported to be infected with the monkey pox virus throughout Africa [4]. Although humans and monkeys serve as in advertent hosts, the reservoir is still unknown. The United States unintentionally imported infected rodents from Western Africa, which resulted in the first cases of human monkey pox in the Western Hemisphere. According to research from a 2003 outbreak in the United States, the method of transmission and level of exposure, such as a bite mark or contact with an infected animal, can affect how severe the clinical signs of monkey pox infections are [15].

Close contact with infected skin lesions can also cause transfer, as can human-to-human droplet transmission. It could take a lot of time to talk to someone face to face for transmission to happen [16]. In general, there are extremely less transmission from person to person [17]. However, a monkey-pox

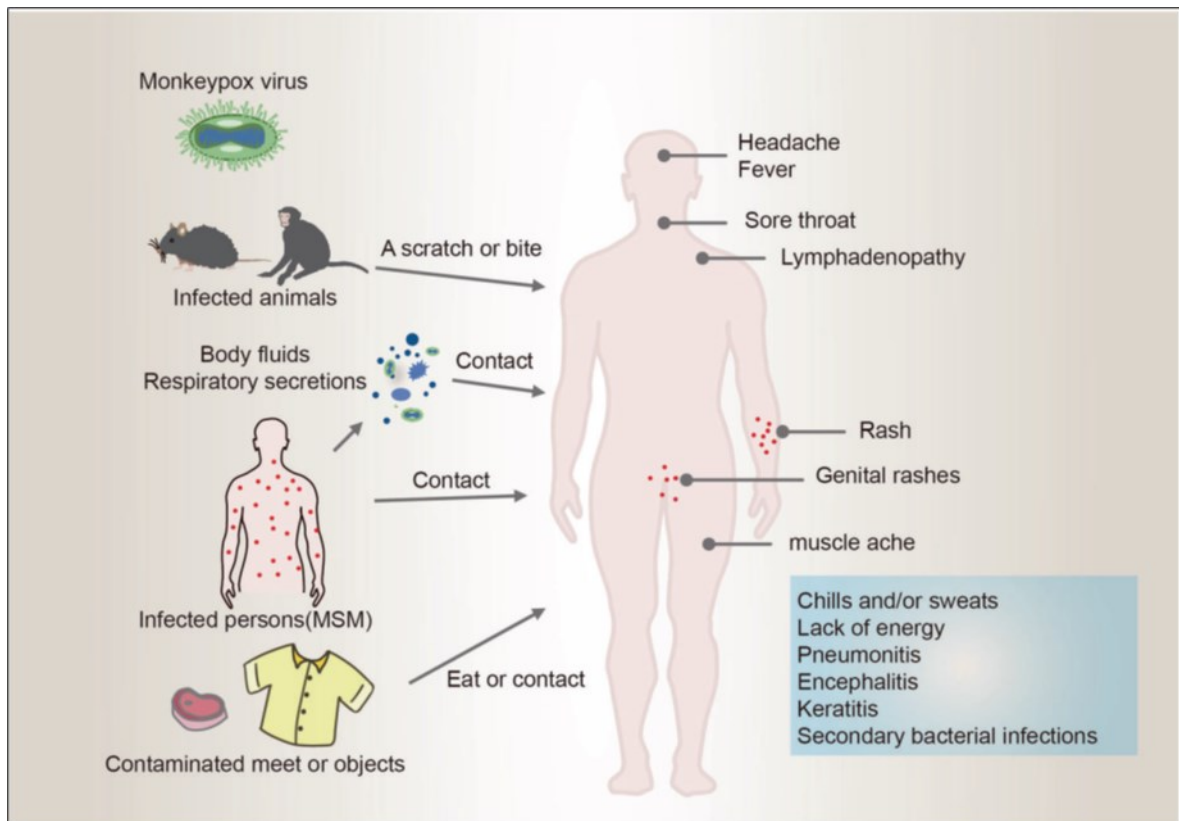


Figure 2. Shows the transmission and symptom of monkey pox using schematic [19].

out break with over 90 confirmed cases was reported in May 2022 in numerous non-endemic nations [4]. The most likely method of transmission in this outbreak may include intimate contact with infected skin lesions during sexual interaction [4, 18]. (figure 2)

#### *Risk factors*

Although monkey pox still affects the continent's monkey and rodent populations, it can rarely spread to people through bites or contact with infected animals. Once a person is sick, they can pass the infection to other people by touching their body fluids to their sore or by exhaling respiratory droplets. When someone contacts their eyes or mouth without first cleaning their hands, monkey pox can transmit through the fluids from their sores or cough that land on environmental objects like blankets or countertops [20].

#### *Pathogenesis*

In contrast to extracellular enveloped virions, which are specialized intracellular mature virions confined by an antigenically different triple membrane, intracellular mature virions are single membrane-bound and only released following host cell lysis. These two forms of the virus are produced during in the pathogenesis of human monkey pox [21, 22]. It has been shown that extracellular enveloped virion antigen-deficient vaccinations and antibodies offer less protection than those that do [23, 24]. The completion of the virus infectious cycle depends on two multi-subunit complexes, retrograde protein from the Golgi and the conserved oligomeric Golgi complex [23]. The Golgi-associated retrograde protein complex, which is responsible for transporting retrograde endosomes, is made up of the four vacuolar protein sorting genes VPS51, VPS52, VPS53, and VPS54. All but VPS53, which is particularly

enriched in the central African clade, were found to be enriched in central African and west African clades [25].

The preserved oligomeric Golgi complex, which has two lobes (lobe A and lobe B) each with four related subunits, is necessary for maintaining Golgi structure and regulating intra-golgi traffic [23]. While conserved oligomeric Golgi three and four are solely enriched in the clade from central Africa, conserved oligomeric Golgi seven and eight are enriched in both clades [3]. The much more crucial oligomeric Golgi four and seven subunits for viral fusion are maintained [23]. Bioinformatics investigation of the human monkey poxvirus of central Africa revealed two different portions (R1-open reading frame 17 to 32 and R2-open reading frame 179 to 193) that may be deleted to lessen the severity of the human monkey pox virus. The mortality and morbidity of mice were decreased, while viral replication was slowed down, when one or both of the areas were deleted. The most successful method of reducing viral virulence was a combined deletion of R1 and R2 [25].

#### *Sign and symptoms*

Monkey pox has signs and lesions that are difficult to differentiate from smallpox in its clinical presentation [17, 27]. Despite monkey pox, clinical signs are less severe than smallpox and the disease is more severe in people with impaired immune systems [28]. When rashes occur, the illness starts with non-specific symptoms and indications such as fever, chills, headache, lethargy, myositis, lymph node

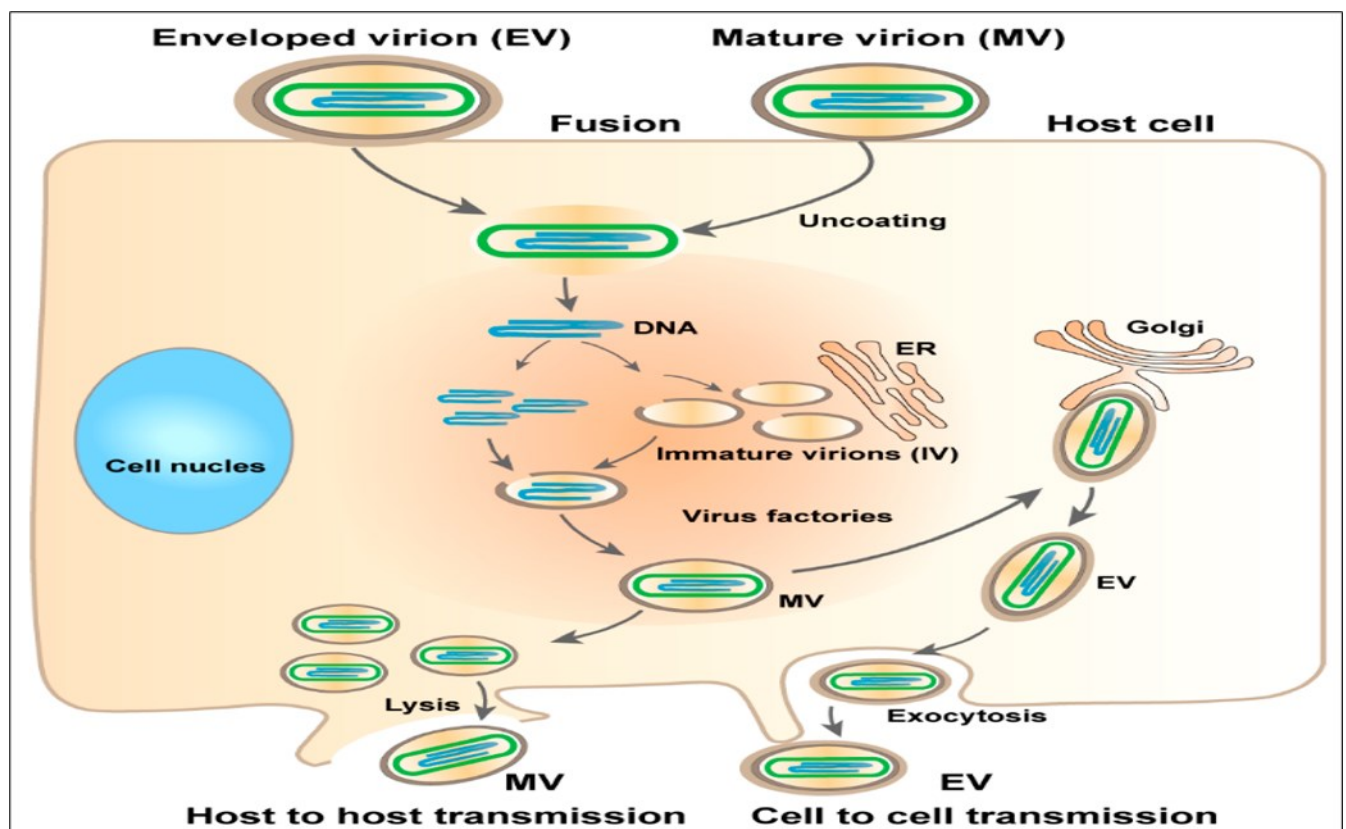


Figure 3. Life cycle of Monkey pox virus; source: [26]

swellings, back pain, and muscle aches. Allergic reactions of all sizes start to occur 1 to 5 days after the fever starts, first on the face and then spread to the body, hands, legs, and feet. The rash proceeds through multiple phases of development, starting with blisters, papules, vesicles, and abscesses, and then it resolves overtime with crusts and scabs that go off when you get better. The incubation time is thought to last for 5 to 21 days, while symptoms and indicators last for 2 to 5 weeks [29]. (figure 3)

#### *Morbidity and Mortality*

Monkey pox has been most frequently observed in children and young people in rural areas of Africa. Those who live in or adjacent to highly forested areas, where the virus is known to be common in animals, are affected in the majority of instances. Infants, small children, and persons with impaired immune systems are most at risk of dying from monkey pox. The second week of illness is often when death occurs in Central Africa, when the mortality rate is roughly 10% [30, 31]. The outbreaks in the US did not result in any fatalities. While 7 people died in the most recent incident in Nigeria, the better outcomes in the United States may be attributable to a healthier patient group, more accessibility to supportive medical care, and a less virulent strain of monkey pox that was imported from Ghana in West Africa [12]. Four of these deaths involved vulnerable people [9].

#### *Public Health Importance*

In West Africa, in regions with frequent contact between humans and wild animal reservoirs, and in particular where there is evidence that the infectious attack rate is rising, monkey pox has already been identified as a growing public health hazard. Interms of the beginning of symptoms, when the rash first appeared and where it appeared [32]. The danger of death from monkey pox is highest in infants, youngsters, and immune-weakened people, while it is often less severe than smallpox interms of complication rate. In Central Africa, mortality typically occurs during the second week of sickness and the fatality rate is around 10% [30, 33].

Concern has previously been expressed regarding the appearance of the monkey-pox virus and the similarity between its clinical presentation and that of smallpox [33]. Clinically separating monkey pox from chicken pox, an unrelated herpes viral illness, has proven difficult during epidemics. But there is also a need for caution in cases of zoonotic infections with other orthopox viruses. Various human cases of outbreak of buffalo pox have been reported in India [34]. Similar to how there is proof of human infections during outbreaks of vaccinia virus infection in Brazilian cattle [35].

#### *Diagnosis*

The World Health Organization and the US Centers for Disease Control have suggested case classifications for the monkey pox outbreak of 2022 that incorporate clinical, epidemiological, and laboratory data. Some examples of diagnostic testing include virus isolation, electron microscopy, real-time polymerase chain reaction, enzyme-linked immunosorbent assays, and immunofluorescent antibody assays [31, 36]. On electron microscopy, the distinctive brick-shaped virions of the pox virus are visible. However, these characteristics can also be found in other viral infections. The histopathologic investigation may show spongiosis, significant spongiosis, cutaneous edema, and acute irritation [37].

#### *Treatments*

The human monkey virus is not specifically treated. The Monkey Pox Virus is completely protected by a special vaccine. Cross-reactivity with the smallpox vaccine can result in cross-immunity, partial immunity to infection, and areduction in clinical outcomes, but the potency of such a protective impact is fading due to waning vaccine-derived immunity. Effective management of human-monkey infection is based on proper supportive therapy along with vigorous treatment of sequelae [38]. Although later vaccination made from viral variations that don't multiply inside of cells have been licensed for use with human monkey infection, earlier vaccinations for vaccinia had less than ideal safety profiles. The Centers for Disease Control and Prevention in the United States provides a comprehensive list of potential treatments for human-monkey infection [39]. Tecovirimat is an antiviral medication that has been tried on numerous animal species and has proven effective against Orthopox virus infections [40].

#### *Prevention and Control*

It is extremely difficult to stop the spread of the monkey-pox virus in prevalent locations, which requires avoiding all contact with rodents and primates as well as preventing direct exposure to blood and uncooked foods [1]. Because this meat may be the only source of nourishment for the world's poorest, attempts to stop the trade in bush meat and the eating of wild animals are very challenging from a cultural and economic standpoint. To raise public awareness and provide guidance on the handling of suspected animal reservoir species-including the use of gloves, protective gear, surgical masks, and avoiding direct contact with infected people-massive health education programs are required. The prevention of human-to-human transmission in health care depends on disease control techniques. Health care providers as well as those treating or coming in contact with patients who have monkey pox should be immunized against smallpox by national health authorities. According to estimates, receiving smallpox vaccination offers 85% cross-protection towards monkey-pox [41].

Animal epidemics can definitely be avoided by isolating newly afflicted animals. To prevent the virus from spreading to fomites, which then serve as a source for future infections, better hygiene practices are necessary. In order to safeguard animals, vaccination with the vaccinia virus may be an option. It is important to house these species separately and to decontaminate and disinfect the areas in which these animals have been maintained since diseases have been linked to Asian monkeys mixed with African primates. To prevent the spreading of the virus, those who have been exposed to the monkey pox virus should stay away from all animals, especially rodents and non-human primates [42].

#### *Vaccination*

At the moment, there is no vaccine approved for use against monkey pox. The vaccine against the vaccine virus offers some defense against other orthopox viruses. According to data from investigations in to African outbreaks, vaccination against smallpox within the past 15 years can be up to 85% effective in preventing infection with human monkey pox [18]. Within four days of infection, the small pox vaccine can prevent or alter the clinical course of human infection. Imvanex, a third-generation pox vaccine, was created for people for whom earlier versions of the vaccine were not advised [43, 44]. In the United States, Imvanex has also been given a specific license for the treatment of human monkey pox infection [44]. The treatment of human monkey pox infection events has been found to be successful when using Modified Vaccinia Ankara (Bavarian-Nordice). Compared to earlier smallpox vaccine generations, Imvanex has better safety characteristics. The European Medicines Agency approved it in 2013 for adults to receive the smallpox vaccine [45, 46].

### Role Of One Health Approach Against Monkey-Pox

Monkey-pox management needs a critical role in development using a One Health approach that prioritizes the health of people, animals, and the ecosystem. The importance of one health strategy in the control and prevention of monkey pox is In order to prevent and contain the spreading monkey-pox outbreak, it is important to increase the much more exposed populations' health education and awareness as well as the effectiveness of information sharing against online rumors and false information [4].

One Health research agenda on pandemics and epidemics is related to poverty to improve regional and local surveillance, preparedness, and response efforts, support the global health security agenda- and strengthen international health regulations and global security efforts against the monkey pox outbreak. Moreover, one health facility advises two smallpox vaccinations preventing monkey pox for any one at risk of occupational contact, including technicians, healthcare professionals, and line employees [47].

In order to assist decision-makers in weighing the most recent scientific evidence when making risk-based decisions and avoiding needless trade barriers, WOAHO/OIE collaborates with experts and partners like WHO to gather the most recent scientific information and reports from the field. Additionally, WOAHO develops risk guidance for people who own domestic and exotic pets as well as those who work with animals [48].

The Pan American Health Organization (PAHO) has established an incident management team with the active participation of personnel from over 15 entities to ensure a timely response to the outbreak and lead preparedness efforts in the member states. WHO is supporting the member states with surveillance, preparedness, and outbreak response activities for monkey pox in affected countries. It has also activated its standard emergency procedures and established these teams [49]. The WHO Information Network for Epidemics is being used by WHO to collaborate with international communities of practice to educate stakeholders and the general public; it also provides real-time intelligence on problems and best practices in monkey pox prevention, testing, and treatment. Collaborating with researchers, partners, and producers of medical countermeasures to analyze global supply and demand, promote the manufacturing of more vaccines, and support equitable access [50].

WHO By providing technical direction, supplemental support, and resource mobilization for emergency response at the international, regional, and national levels, assisting national authorities in developing or upgrading one health-based coordination mechanisms and public health capacities at the national and sub-national levels. In order to ensure monitoring, epidemiological investigation, and contact tracing that include impacted communities, animal contacts, and leverage strategies and lessons, WHO continues to support national authorities. The WHO has also supported the scaling up of testing across all six WHO regions and the genomic sequencing of the monkey pox virus discovered in the present outbreak. It has also provided diagnostic capability, trainings, and ensured centralized procurement and transportation of diagnostic kits [51].

As part of its efforts, the FAO strengthened cross-sectoral cooperation, built up the capacities of nations affected by zoonotic illnesses like monkey pox, and established a worldwide early warning system for transboundary animal diseases. Also, FAO plays a significant role in helping nations by offering technical assistance and advice, filling in any gaps in epidemiological knowledge, and assisting national laboratories to better comprehend the disease condition [52].

### Conclusion And Recommendations

Formerly endemic to some regions of Africa, the monkey pox virus is now causing concern globally after isolated cases in the western hemisphere were confirmed. Since the Democratic Republic of the Congo reported the first incidence of monkey pox in 1970, it has spread to numerous countries both inside and outside of Africa. Most often, respiratory droplets or direct contact with the skin lesions of a sick person are the routes by which human-to-human transmission occurs. The two molecular subtypes of the monkey pox virus are the central African or Congo type and the West African type. The two countries most adversely affected are Nigeria and the Democratic Republic of the Congo. Rats, squirrels, dormice, and non-human primates are just a few of the species that can contract monkey pox.

Therefore, up on the above conclusion, the following recommendations can be forwarded:

- ⇒ Develop the capability for monkey pox genomic sequencing and laboratory diagnosis.
- ⇒ Boost current monkey pox surveillance initiatives.
- ⇒ Create and disseminate risk communication messages for the general public as well as specific populations currently affected and at risk, such as children and immune-compromised people.
- ⇒ Develop knowledge about infection control and clinical management strategies for monkey pox.
- ⇒ If you have monkey pox, follow the appropriate isolation methods advised by your healthcare professional to reduce the risk of spreading the virus to people and animals, including pets and other animals that might be vulnerable to monkey pox infection.
- ⇒ Use an alcohol-based hand sanitizer or soap and water to effectively wash your hands, especially following contact with any infected humans or animals.

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