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Monkeypox: a compendious review of its outbreak, transmission, contagion and prevention

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ABSTRACT:

Monkeypox is a zoonotic disease, caused by a virus that is contracted from sick animals, most frequently rats, to human beings. Also, it can spread to other people. An outbreak cannot be easily sustained by person-to-person transmission alone. The viral metazoan of monkeypox was recognized in Congo Basin and West Africa; the virus from the Congo Basin is more virulent than any other globally.

A thorough review of the literature was conducted using PubMed databases and documents from various health organizations, including the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), the European Centre for Disease Prevention and Control, and the Nigeria Center for Disease Control (NCDC).

Presently, the world is experiencing an outbreak of the disease globally, with cases recorded in developing and developed countries. In this review, the authors provided an overview of monkeypox disease, global incidence rates, mode of transmission, and, most importantly, preventive measures.

It was concluded that, for monkeypox disease to be prevented, there must be a holistic synergy between all sectors globally, with the WHO leading this front by first designating the disease as a significant global health problem. Likewise, disease surveillance measures, adherence to preventive measures, sensitization programs, provision of vaccines, funds, and other logistical supports are recommended to prevent and control monkeypox disease globally.

Keywords: *Zoonotic diseases, Monkepox virus, Prevention, Global health problem.*

INTRODUCTION

Monkeypox is a communicable disease that can spread from animal-human beings and human-human; an outbreak cannot be easily sustained by person-to-person transmission alone (World Health Organization)[1]. Monkeypox virus, which belongs to the *Orthopoxvirus* genus in the *Poxviridae* family, is the causative agent of the disease (subfamily *Chordopoxvirinae*). The viral clades from the Congo Basin and West Africa have been identified[1]. The variola (smallpox) virus and the monkeypox virus are similar to orthopoxviruses, and in a few laboratory tests, it is impossible to differentiate between them. Epidermal monkeypox (BEMP), a poxviral illness of monkeys caused by the tanapox virus, an antigenically unrelated member of the *Poxviridae* family, must be distinguished from monkeypox[2,3].

Humans, caged or wild non-human mammals, and rodents, in particular, are occasionally afflicted with monkeypox, a zoonotic viral illness endemic to Western and Central Africa. It is believed that approximately 10% of human cases during outbreaks in some parts of Africa are fatal due to the particularly lethal Congo Basin monkeypox viruses[2]. West African viruses typically

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result in a milder illness. However, deaths can occur in young infants, people with subsequent bacterial sepsis, those with uncommon complications, including encephalitis, and immunosuppressed adults[4]. Over the years, facilities housing non-human monkeys have occasionally reported[4] monkeypox epidemics.

Due to the major outbreak in Nigeria in 2017-2018, there were numerous imported cases among tourists to Europe and Asia, with one point ultimately leading to person-to-person transmission to a hospital employed[5]. In Africa, human illnesses almost always occur[6]. In addition, the transfer of a virus from exotic pets to humans, resulted in an outbreak in the US in 2003. In prospective animal reservoirs, including prairie dogs or released exotic pets, early detection of imported monkeypox can help stop the disperse of this disease around the world[7]. Consequently, this review provides detailed information on various ways of preventing the transmission of monkeypox.

SOURCES OF REVIEWED LITERATURE

From February to November 2022, a thorough review of the literature was conducted using PubMed databases and documents from various health organisations, including the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), the European Centre for Disease Prevention and Control, and the Nigeria Center for Disease Control (NCDC). The research considered in this study are systematic reviews, and review articles. The search terms utilized were monkeypox, pandemic, epidemiology, outbreaks, and preventive strategies. Additionally, the author that made up the group that worked on writing this review included experts in infectious illnesses and health promotion.

VIROLOGY

The *Poxviridae* family of double-stranded RNA viruses infects a wide range of animals, including birds, reptiles, insects, and mammals. *Entomopoxvarinae* and *Chordopoxvirinae*, each having 18 genera and 52 species, are two of the family's subfamilies (with four genera and 30 species). The *Chordopoxvirinae* subfamily of the *Poxviridae* family, which includes the *Orthopoxvirus* genus, is where monkeypox originates[8,9]. Variola (smallpox), Cowpox, Monkeypox, Vaccinia, Camelpox, Alaskapox, Yaba monkey tumour virus, Tanapox virus, Orf virus, Pseudocowpox virus, Bovine papular stomatitis virus, Buffalopox, and Molluscum contagiosum have all been linked to human diseases. Humans are the reservoir host for the Molluscum contagiosum and Variola viruses[9]. The monkeypox virus (MPXV) has been able to circulate in wild animals for a long time while sporadically infecting people through spillover occurrences because of its wide range of potential hosts[10]. Because *Orthopoxviruses* (OPXV) display immunological cross-reactivity and cross-protection, infection with any member of the genus affords some protection against infection with any other members of the same genus[10,11].

EPIDEMIOLOGY AND HISTORICAL OUTBREAKS

Monkeypox is an endemic disease in several countries in Central and West Africa, including the Democratic Republic of the Congo (DRC), Cameroon, Central African Republic, Cote d'Ivoire, Gabon, Liberia, Nigeria, Republic of the Congo, and Sierra Leone. Most illnesses are sporadic or connected to small outbreaks[12-14].

Most infections apart from the endemic regions are associated with global travel or the importation of animals with MPXV[15]. Before 2022, instances in countries other than Africa were previously documented[13] in the US, UK, Israel, and Singapore.The Central African clade and the West African clade are the two separate genetic clades of the MPXV[14].

While the Central African (Congo Basin) clade has historically been linked to increased transmissibility and case-fatality ratios as high as 10%, infection with the West African clade often results in a more self-limited disease with case-fatality ratios estimated to be between 3-6%[14]. Both clades have only been confirmed in Cameroon[16,17]. However, more suspected cases of the Central African clade than the West African clade have thus far been reported[16] collectively because of the high number of cases reported in previous and ongoing outbreaks in the DRC.

CURRENT SITUATION AND TRENDS

As of November 10, 2022, instances had been detected[18] in Central America and Europe; 1,444 suspected cases were reported[18] in Canada; 28,599 confirmed[19,20] in USA. Australia reported[21-23] 141 confirmed cases of MPXV (Health professionals and the Victorian community – 2022). Israel reported[21] 262 confirmed cases of MPXV. European Centre for Disease Prevention and Control (ECDC) stated that MPXV cases have lately been documented[3] in all twenty-seven EU Member States.

In the United Kingdom, 3,701 confirmed cases of MPXV have been reported[22]. Portugal reported[19] 944 confirmed cases of monkeypox. Spain confirmed[23,24] 7,336 cases. Belgium reported[25,26] 785 confirmed cases. Germany confirmed[27] 3,670 cases. In France, 4,097 confirmed cases were reported[28]. In Italy 914 confirmed cases of MPXV were reported[24]. In Sweden, 212 MPXV confirmed cases were reported[29]. The Netherlands confirmed[30] 1,240 cases. Austria reported[31] 325 confirmed case. Nine EU/EEA Member States reported[3,28] 25,375 confirmed cases, Region of the Americas reported[3] 52,495 confirmed cases, African Region reported[3] 962 confirmed cases, South-East Asia Region reported[3] 31 confirmed cases, Western Pacific Region reported[3,28] 216 confirmed cases as of November 2022[3] (Table 1).

Table 1. Number of confirmed monkeypox cases and deaths across countries reported to WHO, by country, from January 1, 2022, to November 10, 2022.

	Total Confirmed Cases	Total Probable Cases	Total Deaths
Region of the Americas			
United States of America	28,599	0	11
Brazil	9,541	788	11
Colombia	3,630	0	0
Peru	3,269	0	0
Mexico	3,006	446	4
Canada	1,444	88	0
Chile	1,208	17	0
Argentina	746	0	0
Ecuador	311	1	2
Bolivia (Plurinational State of)	245	0	0
Puerto Rico	201	0	0
Guatemala	111	4	0
Dominican Republic	52	1	0
Panama	21	0	0
El Salvador	17	0	0
Jamaica	16	0	0
Costa Rica	15	0	0
Uruguay	14	0	0
Honduras	10	0	0
Venezuela (Bolivarian Republic of)	10	0	0
Cuba	8	0	1
Paraguay	6	0	0
Aruba	3	0	0
Curaçao	3	0	0
Bahamas	2	0	0
Guyana	2	0	0
Barbados	1	0	0
Bermuda	1	0	0
Martinique	1	0	0
Guadeloupe	1	0	0
Saint Martin	1	0	0
European Region			
Spain	7,336	0	2
France	4,097	0	0
The United Kingdom	3,701	0	0
Germany	3,670	0	0
Netherlands	1,240	0	0
Portugal	944	0	0
Italy	914	0	0
Belgium	785	0	1
Switzerland	546	0	0
Austria	325	0	0
Israel	262	0	0
Poland	212	0	0
Sweden	212	0	0
Ireland	210	0	0
Denmark	191	0	0
Norway	93	0	0
Greece	84	0	0
Hungary	80	0	0
Czechia	70	0	1
Luxembourg	55	0	0
Slovenia	47	0	0
Romania	44	0	0
Finland	42	0	0
Serbia	40	0	0
Malta	33	0	0
Croatia	29	0	0

Continued

Table 1 ***(continued).*** Number of confirmed monkeypox cases and deaths across countries reported to WHO, by country, from January 1, 2022, to November 10, 2022.

	Total Confirmed Cases	Total Probable Cases	Total Deaths
Iceland	16	0	0
Slovakia	14	0	0
Türkiye	12	0	0
Estonia	11	0	0
Bosnia and Herzegovina	9	0	0
Bulgaria	6	0	0
Gibraltar	6	0	0
Latvia	6	0	0
Cyprus	5	0	0
Lithuania	5	0	0
Ukraine	5	0	0
Andorra	4	0	0
Monaco	3	0	0
Georgia	2	0	0
Greenland	2	0	0
Montenegro	2	0	0
Republic of Moldova	2	0	0
Russian Federation	2	0	0
San Marino	1	0	0
African Region			
Nigeria	604	0	7
Democratic Republic of the Congo	206	0	0
Ghana	107	0	4
Cameroon	16	0	2
Central African Republic	12	0	0
Congo	5	0	0
South Africa	5	0	0
Benin	3	0	0
Liberia	3	0	0
Mozambique	1	0	1
Western Pacific Region			
Australia	141	0	0
New Zealand	33	0	0
Singapore	19	0	0
Japan	7	0	0
China1	6	0	0
Philippines	4	0	0
Republic of Korea	2	0	0
Viet Nam	2	0	0
New Caledonia	1	0	0
Guam	1	0	0
Eastern Mediterranean Region			
Lebanon	18	0	0
Sudan	18	0	1
United Arab Emirates	16	0	0
Saudi Arabia	8	0	0
Qatar	5	0	0
Morocco	3	0	0
Iran (Islamic Republic of)	1	0	0
Jordan	1	0	0
Bahrain	1	0	0
Egypt	1	0	0
South-East Asia Region			
India	17	0	1
Thailand	12	0	0
Indonesia	1	0	0
Sri Lanka	1	0	0
Total	79,151	1,345	49

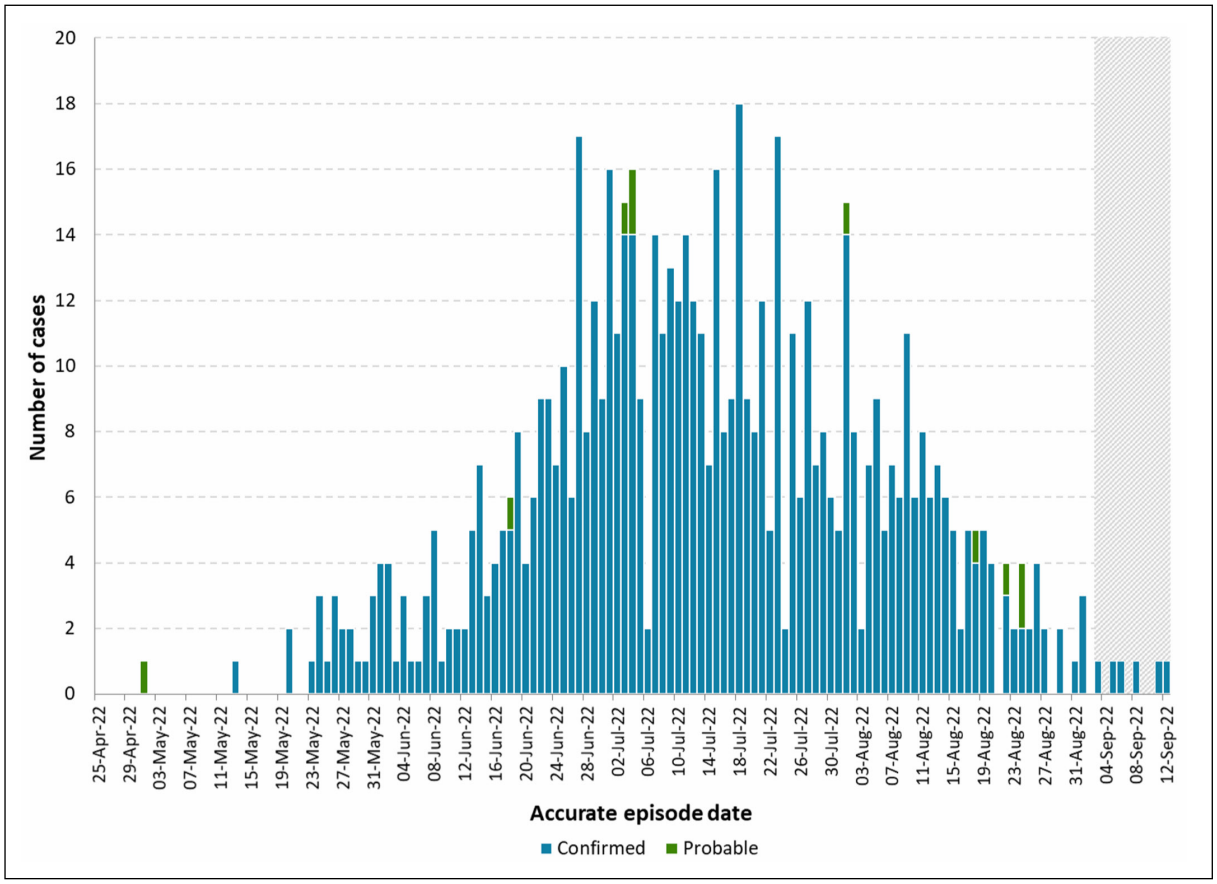

Figure 1. Cases of the monkeypox with accurate episode dates and case grading in the world[23].

In general, countries in West and Central Africa continue to report[3] MPXV outbreaks. In December 2021, Cameroon reported[3] an MPXV outbreak; as of February 17th, 2022, there had been three verified cases, 25 suspected cases and two fatalities. Cases have been reported[3] from nations in the continent's Centre, Northwest, and Southwest. Also, the majority of the continent's regions reported[3] at least one case between 2020 and 2022 (Figure 1).

On March 14, 2022, the Central African Republic (CAR) reported[5] six MPXV instances with fatalities. Between January 1 and April 17, 2022, 54 health zones in 14 provinces of the Democratic Republic of the Congo registered[5] 1,152 probable MPXV cases, including 55 fatalities (a case-fatality rate of 4.8%). In 2021, 138 suspected cases and 14 fatalities were reported[3,5] in the same time frame.

According to research, the MPXV, currently present in the DRC and CAR, represents the more hazardous Congo Basin (CB) branch of the virus. Nigeria reported[5] 46 suspected cases of MPXV between January 1 and April 30, 2022, of which 15 were confirmed. Between 2017 and 2022, Nigeria reported[3,5] 277 confirmed cases (varying from 8 to 88 per year), eight of which were fatal (Case fatality ratio, CFR 3.3%) (Table 2, Figure 2).

Table 2. Number of confirmed monkeypox cases and deaths reported to WHO, by WHO Region, from January 1, 2022, to November 10, 2022.

	Total Confirmed Cases	Total Probable Cases	Total Deaths	Cases in past week[1]	7-day % change in cases[1]
Region of the Americas	52,495	1,345	29	1,266	7%
European Region	25,375	0	4	51	-49%
African Region	962	0	14	24	-29%
Western Pacific Region	216	0	0	6	500%
Eastern Mediterranean Region	72	0	1	0	0%
South-East Asia Region	31	0	1	1	0%
Total	79,151	1,345	49	1,348	2%

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, USG: Ultrasonography.

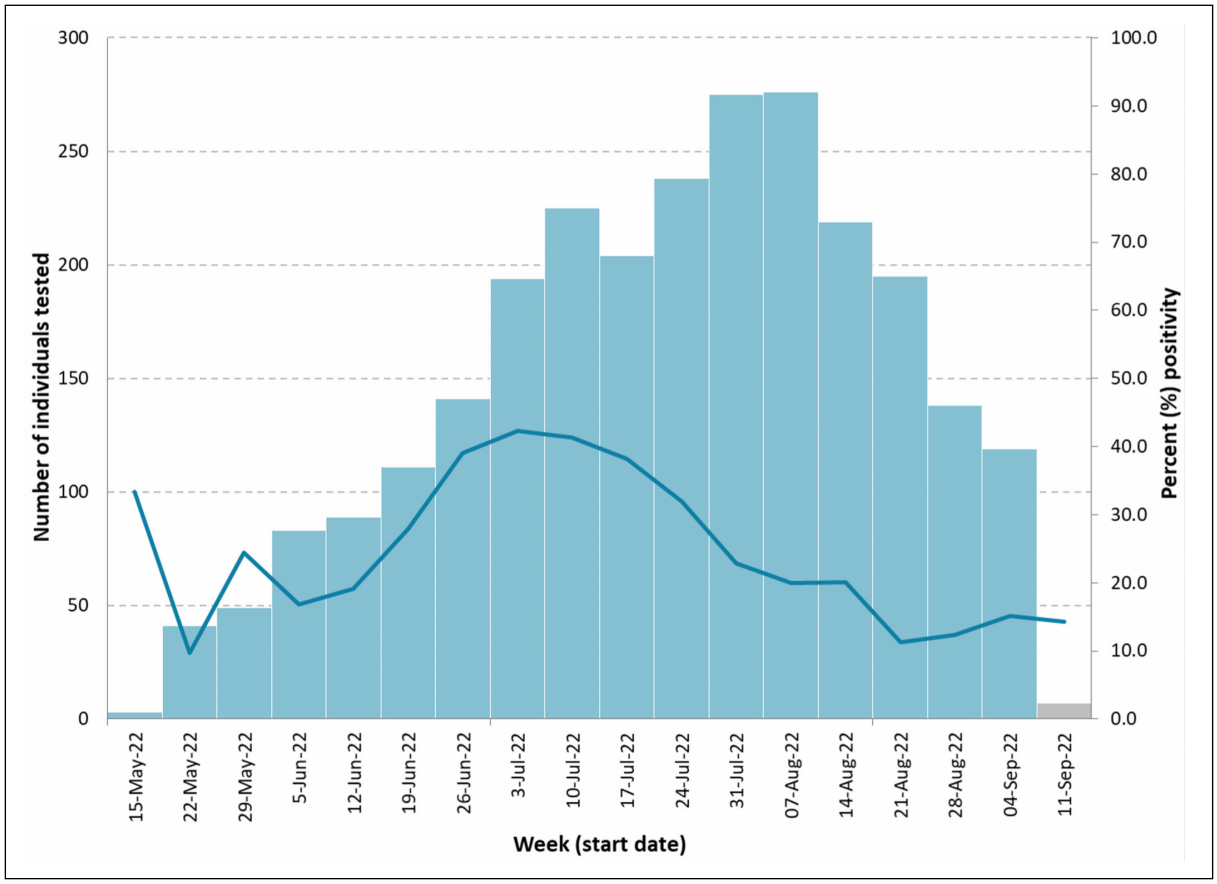

Figure 2. The number of people tested for monkeypox and the percentage of positive results per week in the world[32].

MODES OF TRANSMISSION

As shown in Figure 3, the monkeypox virus is thought[4] to have a variety of ways of transmission, all of which are linked to close contact with sick humans or animals. Human-to-human transmission may be triggered by close contact with respiratory secretions, skin lesions on an infected person, or recently contaminated objects. Droplet respiratory particles often need prolonged face-to-face contact to transmit the disease, which puts health workers, household members, and other close contacts of active cases at risk[4]. However, it is documented[4,33] that chain of transmission in a community, the number of person-to-person infections has climbed from 6 to 9 in recent years.

Potential Sexual Transmission

Although data point to people with a history of direct physical contact with a symptomatic person as at-risk groups for MPXV transmission, there is another method of probable transmission. According to the currently available information, men who have sex with men (MSM) account for most of MPXV cumulative instances[35]. One risk factor identified by the WHO is sexual interaction with one or more sexual partners in the 21 days preceding the beginning of symptoms. That raises the question of whether this sickness could be transmitted sexually. For instance, it was reported[36] that cases of MPXV in a research, affirmed that 54 MPXV cases presenting at health facility in the UK were MSM. The most significant risk factor for MPXV in specific populations, especially among MSM, may be sexual interaction, which accounts for the startling amount of cases that fall under this category. According to the CDC, a sizable majority of those affected by the current worldwide monkeypox outbreak also had human immunodeficiency virus (HIV) and other sexually transmitted infections (STI).

Gay, bisexual, and other men who have sex with men have been the most affected by the outbreak. The co-occurrence of monkeypox cases and STI diagnoses in the previous year suggests[37] a potential bias that people with known HIV infections or STIs may be more likely to seek out sexual health care providers when they experience monkeypox symptoms. Similarly, healthcare professionals who specialize in HIV and STI treatment may be able to identify monkeypox symptoms and perform virus testing. The findings[35,37] imply that the transmission of monkeypox may be associated with people who have HIV infection, highlighting the significance of giving monkeypox vaccine priority for people with known HIV infection and STIs.

Incubation Period

The monkeypox virus can be transferred from one person to another by contact with lesions, body fluids, re-

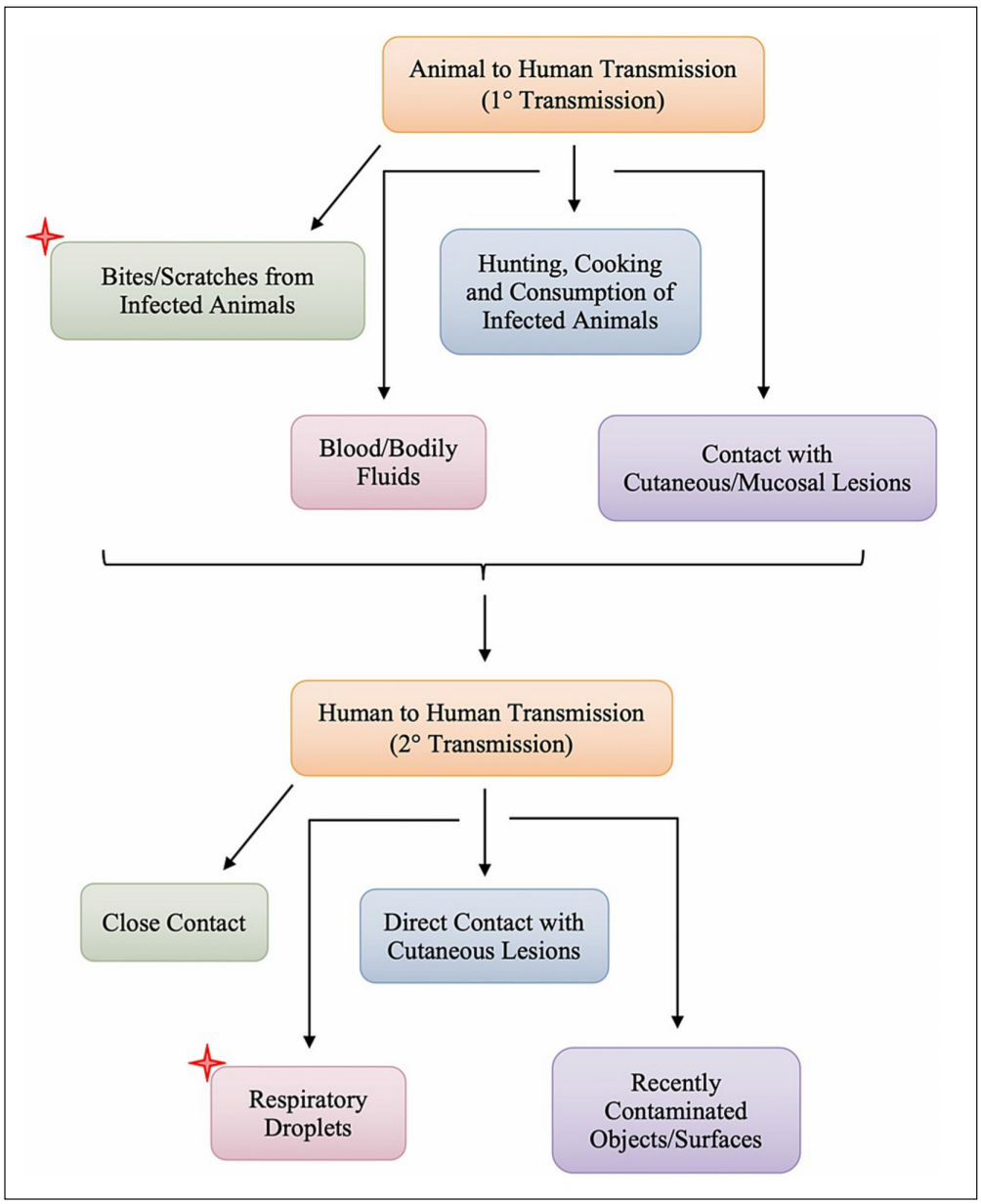

Figure 3. Suspected modes of monkeypox transmission to humans[34].

spiratory droplets, and infected items like bedding. The incubation period for monkeypox normally lasts 6 to 13 days, although it can last up to 21 days[3].

Signs and Symptoms

There are two distinct eras of the infection:

- Invasion Stage
  The 0-5-day invasion stage, which is marked by a high fever, a strong headache, lymphadenopathy, back pain, myalgia (muscle aches), and severe asthenia (lack of energy). MPXV has a distinguishing characteristic termed lymphadenopathy that sets it apart from other infections that could initially appear to be identical (chickenpox, measles, smallpox)[3]
- Skin Eruption Stage
  The skin eruption frequently begins one to three days following the onset of a fever. The rash typically appears on the front and limbs rather than the trunk. In 95% of cases, it also affects the soles of the feet and the palms of the hands (in 75% of cases). Oral mucous membranes, genitalia, and conjunctivae are also affected in addition to the cornea (in 70% of cases)[3]. The rash starts off as flat, solid lesions called macules, then develops into papules, which are slightly elevated, hard lesions, vesicles, which are clearly filled with fluid, pustules, which are filled with a yellowish fluid, and crusts that eventually dry out and break[38].

PREVENTION

A multimodal strategy is essential to prevent, control, and lower the incidence of monkeypox morbidity and death. Importantly, a combination of government political will and surveillance will aid to track the outbreak and help to reduce the spread of MPXV. The primary preventative method for monkeypox involves increasing public knowledge of risk factors and teaching individuals about the steps they may take to lessen virus exposure. The following are additional precautions:

Vaccination

Vaccination for the prevention and control of monkeypox is currently the subject of a scientific review of its viability and applicability. However, some countries have policies in place or are developing them to give vaccines to individuals at risk, such as laboratory employees, quick response teams, healthcare professionals, MSM, sex workers, and people in pre-exposure prophylaxis (PrEP).

JYNNEOS, the Modified Vaccinia Ankara (MVA) vaccine, was authorized in 2019 for use in individuals 18 years of age and older, who have been found to have a high risk of contracting smallpox or monkeypox. JYNNEOS is given in two doses, separated by four weeks (28 days), under the skin (subcutaneously)[39]. The current outbreak of monkeypox cannot be contained with a single dose of JYNNEOS since there is no evidence that it will offer long-lasting protection[38].

Vaccines, like any medicine, can have side effects. The most common side effects are usually mild and go away on their own[6]. They include the following:

Injection site reactions, including pain, redness, swelling, hardening of the skin, and itching. Injections site reactions, except for pain, may occur more frequently after intradermal administration than after subcutaneous administration.

- Headache
- Muscle pain
- Fatigue (tiredness)
- Nausea
- Change in appetite
- Chills
- Fever

Reducing the Risk of Human-Human Transmission

Rapid case identification and surveillance are crucial for controlling an outbreak. Intimate contact with ill patients is the greatest risk factor for monkeypox virus infection during human monkeypox epidemics. Healthcare workers and household members are more at risk for infection. When caring for patients with a MPXV infection that have been suspected or confirmed, or when handling specimens from such patients, health workers should adhere to the prescribed infection control methods. The best caregivers are those who have already had their smallpox immunisation.

Reducing the Risk of Zoonotic Transmission

There is proof[4] that a large number of MPVX infections have been spread from animal to human. Therefore, avoiding direct contact with confirmed or suspected contagious wild animals is recommended. Also, it is advised not to handle blood, meat, or other body parts, whether the animal is alive or dead. Additionally, animal meat needs to be properly prepared before consumption.

Preventing Monkeypox by Restricting the Trafficking of Animals

There should be regulations that restrict the importation of rodents and non-human primates. Monkeypox-possible animals housed in captivity should be quarantined immediately and kept apart from other animals. Animals that may have come into contact with an infected animal must be confined, handled with standard safety precautions, and kept under observation for 30 days for indications of monkeypox.

Recommendations

Following this review, the following recommendations are made:

1. Disease surveillance measures must be increased among all countries globally.
2. The populace in Nigeria must strictly adhere to all preventive measures.
3. Sensitisation and education programs on MPXV disease should be increased globally.
4. Vaccines against MPXV disease should be made available to all countries globally.
5. Funds and other logistics support should be made available to all countries, especially developing countries, to combat the current outbreak of monkeypox.

CONCLUSIONS

An outbreak of MPXV is currently happening worldwide, with new cases of the disease occurring globally. This review has provided a general overview of monkeypox disease, focusing on specific preventive measures. Summarily, for monkeypox disease to be prevented, there must be a holistic synergy between all sectors globally, with the WHO leading this front by first designating the disease as a significant global health problem.

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There is no conflict of interest.

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