General Overview

- Monkeypox virus
- Disease
- Mode of transmission
- Ecology and geographical distribution
- Need for collaboration and partnership
Overview

Monkeypox

Multi-country Monkeypox outbreaks: The world needs to be prepared and ready for emerging and re-emerging infectious diseases everywhere.

Dr. Talisuna gives an overview on Monkeypox.

Managing epidemics

Key facts about major deadly diseases

Monkeypox

10 THINGS YOU SHOULD KNOW

1. Monkeypox virus is in the same family of viruses as smallpox virus (Orthopoxviruses).
2. Primary infection occurs through direct contact with body fluids or lesions of infected animals.
4. Isolation of patients and standard infection prevention and control (IPC) measures are key to minimizing any possibility of human-to-human transmission.
5. Avoid contact with animals that could harbour the virus, especially rodents and sick or dead animals.
6. Active surveillance to ensure rapid identification of new cases is critical for outbreak containment.
7. There is no specific treatment or vaccine recommended for Monkeypox.
8. Health education and raising population awareness are the best preventive measures in at-risk populations.
9. Many animal species host the Monkeypox virus, primarily rodent species (rather than monkeys, after which the disease is named).
10. Monkeypox is a rare disease that occurs sporadically in remote tropical rainforest areas of Central and West Africa.
Monkeypox virus

- Monkeypox in captive primates
- Properties of monkeypox virus
- Human monkeypox
- Ecology of monkeypox virus

(A) Acute stage; pustules on the leg and sole of the foot.
(B) Convalescent stage; healing pustules and scars. (From von Magnus et al. (1959), courtesy of Dr. K. L. Fennestad.)
Comparison of DNA Maps of Strains of Monkeypox Virus

Fenner, 1988
A human infection caused by monkeypox virus in Basankusu Territory, Democratic Republic of the Congo

I. D. LADNYJ, P. ZIEGLER, & E. KIMA

This paper presents clinical and epidemiological information on a patient with smallpox-like disease, from whom a monkeypox-like virus was isolated. The patient was the first recognized human monkeypox case in medical history.

“The patient (A. I.) was a 9-month-old boy who became ill with fever on 22 August 1970 and 2 days later developed a rash. He was admitted to Basankusu Hospital on 1 September”.
Cessation of routine smallpox vaccination: emergence of monkeypox disease

Intensified surveillance for smallpox disease:
• Surveillance system was based primary upon health-institutions in the epidemic regions
• Importance of collaboration of hospital and dispensary staff for accurate and complete reporting of cases (detection of cases)
• Examination of monkeypox cases and collection/dispatch of specimens for laboratory testing and thus for confirmation of the clinical diagnosis
  – Specimens (lesion material, sera)
  – WHO Collaborating Centres: at the Centres for Disease Control, Atlanta, USA, or at the Research Institute for Viral Preparations, Moscow, USSR.

Fine et al. 1988
Overview of disease progression

- 5-21 days: Incubation period
- 1-4 days: Febrile stage
- 2-4 weeks: Rash stage
- Days to weeks: Recovery
Disease progression III – Rash stage

- **Macule**
- **Papule**
- **Vesicle**
- **Pustule**
- **Crust**


Credit: Andrea McCollum / CDC

Credit: Toutou Likafi/ Kinshasa School of Public Health

Credit: P. Mbala / Institut Nationale de recherche biomédicale. DRC
Monkeypox, chickenpox, and measles

**Monkeypox**

- Image: WHO / Brian W J Mahy

**Chickenpox**

- Image: Centres for Disease Control and Prevention

**Measles**

- Image: Centres for Disease Control and Prevention
Monkeypox transmission

**Primary infection**
- Animal
- Human
  - Contact with infected animals
  - Contact with contaminated animal products

**Secondary infection**
- Human ➔ Human
  - Contact with infected people
  - Mother to fetus

World Organization

Emergencies programme
Unprotected contact with:
- respiratory droplets
- lesion material
- body fluids
- contaminated materials and surfaces

The virus can enter through:
- respiratory tract
- mucous membranes (eyes and mouth, etc.)
- broken skin (e.g. animal bites, other routes)
Occurrence of monkeypox virus in widely scattered areas of Africa during 1970 -1979

- Sporadic zoonotic infection in remote rural villages in Central and West African countries, now declared as Public Health Emergency of International Concern (PHEIC)
- Clade names Congo Basin becomes I and West African becomes IIa and IIb (clade most seen in global outbreak)

Number of confirmed, probable, and/or possible monkeypox cases between 1970–1979

Number of confirmed, probable, and/or possible monkeypox cases between 1980–1989.

Bunge et al., 2022
Number of confirmed, probable, and/or possible monkeypox cases between 1990-2009.

Number of confirmed, probable, and/or possible monkeypox cases between 1990–1999.

Number of confirmed, probable, and/or possible monkeypox cases between 2000-2009.
Number of confirmed, probable, and/or possible monkeypox cases between 2010 - 2019
Monkeypox outbreak in the WHO African Region

As 12 September 2022

Monkeypox outbreak in the WHO African Region

[Map showing affected countries in the WHO African Region]

Affected countries in the WHO African Region

- Nigeria
  - 277 confirmed cases
  - 6 deaths
  - Last update by the country: Wednesday, September 7, 2022
- Democratic Republic of the Congo
  - 195 confirmed cases
  - 0 deaths
  - Last update by the country: Monday, August 22, 2022
- Ghana
  - 84 confirmed cases
  - 4 deaths
  - Last update by the country: Tuesday, September 6, 2022
- Central African Republic
  - 9 confirmed cases
  - 0 deaths
  - Last update by the country: Monday, August 22, 2022
- Cameroon
  - 7 confirmed cases
  - 2 deaths
  - Last update by the country: Friday, August 26, 2022
- South Africa
  - 0 confirmed cases
  - 0 deaths
  - Last update by the country: Friday, September 2, 2022
- Benin
  - 9 confirmed cases
  - 0 deaths
  - Last update by the country: Wednesday, August 24, 2022
- Liberia
  - 9 confirmed cases
  - 0 deaths
  - Last update by the country: Wednesday, August 17, 2022
- Congo
  - 3 confirmed cases
  - 0 deaths
  - Last update by the country: Friday, September 9, 2022

Cumulative confirmed cases

- Confirmed cases
  - > 220
  - 160
  - 100
  - 60
  - 20
  - ≤ 10

Affected countries

- Yes
- No

Not applicable

https://www.arcgis.com/apps/dashboards/8370608ef8c74ad8bb356673bfc087d
Emerging, re-emerging or adaptation of the monkeypox virus

Transmission Potential of Monkeypox Virus in Unvaccinated Human Populations
Two pertinent questions were addressed in 1988

1) What is the epidemic potential of monkeypox in unvaccinated human population?

2) Is it possible that monkeypox could persist in unvaccinated human populations through continuous-person-to-person transmission?

Emerging, re-emerging or adaption of the monkeypox virus

Monkeypox disease outbreak in multiple countries
Global Epidemiological Situation
Confirmed cases by date of notification

- Since 1 Jan 2022, cases reported to WHO from **103 (1 new)** Member States / territories across all **6 WHO regions**

- As of 12 September 2022, at 17h CEST, a total of **57,607 laboratory confirmed cases (4,602 new)** including **22 deaths (4 new)**, have been reported

- Number of new weekly cases has decreased by 8.5% compared to the previous week

```
data as of 11 Sep 2022 17:00 CEST
```

Source: WHO
Confirmed cases of Monkeypox from 1 Jan 2022, as of 12 Sep 22

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: WHO Health Emergencies Programme
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Regional Epi Curves

data as of 11 Sep 2022 17:00 CEST

African Region

Eastern Mediterranean Region

European Region

Region of the Americas

South-East Asia Region

Western Pacific Region

Number of cases

Date of notification

Source: WHO
Top 10 countries epidemic curves by total reported cases

Note different y-axis scales

Source: WHO
# Demographics (case report forms)

## Case profiles

**As of September 11 2022**

<table>
<thead>
<tr>
<th></th>
<th>Reported values</th>
<th>Unknown or Missing Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Men who have sex with men</td>
<td>12661 (95.0%)</td>
<td>663 (5.0%)</td>
</tr>
<tr>
<td>HIV-Positive</td>
<td>5971 (45.7%)</td>
<td>7108 (54.3%)</td>
</tr>
<tr>
<td>Health worker</td>
<td>322 (4.1%)</td>
<td>7481 (95.9%)</td>
</tr>
<tr>
<td>Travel History</td>
<td>1327 (26.5%)</td>
<td>3690 (73.5%)</td>
</tr>
<tr>
<td>Sexual Transmission</td>
<td>8430 (90.6%)</td>
<td>878 (9.4%)</td>
</tr>
<tr>
<td>Hospitalised(^2)</td>
<td>1792 (9.1%)</td>
<td>17968 (90.9%)</td>
</tr>
<tr>
<td>ICU</td>
<td>11 (0.1%)</td>
<td>8536 (99.9%)</td>
</tr>
<tr>
<td>Died</td>
<td>4 (0.0%)</td>
<td>20898 (100.0%)</td>
</tr>
</tbody>
</table>

\(^1\) Note given true proportions of variables, yes reporting may be common than no reporting

\(^2\) May be hospitalised for isolation or medical treatment
Proportions of Male Cases and MSM

Proportion of cases who are men who have sex with men
data as of September 04 2022

Source: WHO

Proportion of cases who are male
data as of September 04 2022

Source: WHO
## Demographics (case report forms)

### Case profiles

As of September 05 2022

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Men who have sex with men</td>
<td>11923 (95.2%)</td>
<td>607 (4.8%)</td>
</tr>
<tr>
<td>HIV-Positive</td>
<td>5576 (44.9%)</td>
<td>6834 (55.1%)</td>
</tr>
<tr>
<td>Health worker</td>
<td>313 (4.2%)</td>
<td>7070 (95.8%)</td>
</tr>
<tr>
<td>Travel History</td>
<td>1213 (27.9%)</td>
<td>3127 (72.1%)</td>
</tr>
<tr>
<td>Sexual Transmission</td>
<td>7822 (91.0%)</td>
<td>777 (9.0%)</td>
</tr>
<tr>
<td>Hospitalised</td>
<td>1550 (8.4%)</td>
<td>16928 (91.6%)</td>
</tr>
<tr>
<td>ICU</td>
<td>9 (0.1%)</td>
<td>8072 (99.9%)</td>
</tr>
<tr>
<td>Died</td>
<td>4 (0.0%)</td>
<td>19681 (100.0%)</td>
</tr>
</tbody>
</table>

1. Note given true proportions of variables, yes reporting may be common than no reporting.

2. May be hospitalised for isolation or medical treatment.
Potential heterosexual transmission of monkeypox among seven linked casual sexual partners in Bayelsa, Nigeria (2022)

**Relationship between linked sexual partners**

- **CP** (Casual partner)
- **FSW** (Female sex worker)

**Proposed modes of transmission**

**Pre-symptomatic transmission**
- Infected bodily secretions, including genital secretions

**Pre-visible rash transmission**
- Respiratory droplets
- Infected bodily fluids e.g. genital secretions, saliva
- Skin inoculations- shedding of virus before visible skin rash

**Early rash transmission**
- Skin inoculation
- Other infected bodily fluids

**Post recovery transmission**
- Genital secretions
- Skin inoculation from healed skin lesions
- Infected bodily fluids

**Legend**

- Yellow: Febrile prodrome
- Green: Healed lesions
- FSW: Female sex worker
- F: Female
- M: Male
- CP: Casual partner
- Unknown health status
- Genital rash

<table>
<thead>
<tr>
<th>Case</th>
<th>Relationship</th>
<th>Duration</th>
<th>Health Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CP to Case 1</td>
<td>7 days</td>
<td>Female</td>
</tr>
<tr>
<td>2</td>
<td>Case 1 to Case 2</td>
<td>3 days</td>
<td>Male</td>
</tr>
<tr>
<td>3</td>
<td>Case 1 to Case 3</td>
<td>2 days</td>
<td>Female</td>
</tr>
<tr>
<td>4</td>
<td>Case 2 to Case 4</td>
<td>10 days</td>
<td>Male</td>
</tr>
<tr>
<td>5</td>
<td>Case 3 to Case 5</td>
<td>2 days</td>
<td>Female</td>
</tr>
<tr>
<td>6</td>
<td>Case 5 to Case 6</td>
<td>14 days</td>
<td>Male</td>
</tr>
<tr>
<td>7</td>
<td>Case 6 to Case 7</td>
<td>3 days</td>
<td>Female</td>
</tr>
</tbody>
</table>
Transmission of MPX via sexual contact in some parts of Nigeria

“Overall, our study supports our prior hypothesis in the 2017-2018 outbreak where we proposed transmission of MPX via sexual contact in some parts of Nigeria. Additionally, in this study, we report potential transmission of MPV among linked heterosexual casual partners who report high-risk behaviours. These findings call for more enhanced surveillance to identify and understand the role of sexual activity in the transmission of monkeypox in Nigeria.”
Transmission Potential of Monkeypox Virus
Ecology and geographical distribution
Monkeypox virus transmission cycle: need for One Health approach

The Viral Cycle of the Monkeypox Virus

Healthy carriers, natural hosts of the Monkeypox virus

Wild Rodents
Mainly squirrels of the genera Pusticlurus spp. and Heliosciurus spp.

Via bites and scratches or direct contact with the bodily fluids of an infected animal

Exotic pets (rabbits, prairie dogs) are susceptible to infection and can be carriers.

Monkeys are not the reservoir of the virus. They develop the same symptoms as humans.

Through the upper respiratory tract by inhalation of aerosolized or implanted virus, or by inoculation through the skin through contact with fluids contained in macropopular particles.

Animals associated with monkeypox virus

- African dormouse
- Rope squirrel
- Gambian pouched rat
- Sooty mangabey

World Health Organization
Surveillance for monkeypox, transmissibility in wildlife and human population

Key attributes:

- Accuracy/completeness
- Sensitivity
- Specificity
- Timeliness
- Cost
- Simplicity

Human population
Animal population
Environment
Extended One Health approach
AFRIPOX: A One Health approach of monkeypox

Central African Republic (CAR)

- Identification réservoir animal et hôtes intermédiaires
- Facteurs favorisant la prolifération du réservoir et l'augmentation des contacts réservoir/humains
- Développement d’un nouveau test sérologique plus spécifique
- Développement test diagnostic moléculaire de terrain
- Séquençage, phylogénie, phylécographie

- Caractérisation des environnements favorables à la survenue d’épidémie
- Identification des écotopes favorables à la prolifération du réservoir animal
- Ou aux interactions humain/animal
- Changement écologique récents dans les zones touchées

- Anthropologie de la santé et de la maladie
- Approche Ethnobiologique
- Ethnobiologie-pratiques actuelles avec faune sauvage

World Health Organization

Anthropology
Zoology
Ecology
Epidemiology
Virology

AFRIPOX
Anthropology
Zoology
Ecology
Epidemiology
Virology
Links to more information:

- WHO Regional Office for Europe – One health: [link](#)
- CDC – One Health: [link](#)
- WHO - Taking a multisectoral, One Health Approach: A Tripartite guide to addressing zoonotic diseases in countries: [link](#)
- One Health: Basics of multisectoral collaboration at the Human - Animal - Environment interface (online course): [link](#)
Links to more information:

Online introductory training. Monkeypox: Introduction:  
https://openwho.org/courses/monkeypox-introduction

Formation de base en ligne: Variole du singe : Introduction :  
https://openwho.org/courses/variole-du-singe-introduction

Online extended training. Monkeypox epidemiology, preparedness and response:  
https://openwho.org/courses/monkeypox-intermediate

Formation avancée en ligne: Épidémiologie de la variole du singe, préparation et réponse :  
https://openwho.org/courses/variole-du-singe-intermediaire/
THANK YOU
MERCI
OBRIGADO