Introduction to monkeypox
Prevention and control
Monkeypox: Learning objectives

- Understand the emergence of monkeypox
- Describe routes of transmission
- List signs and symptoms
- Identify monkeypox, chickenpox, measles
- Describe laboratory specimens and tests
- Discuss prevention and control strategies

Credit: Am J Trop Med Hyg./ Reynolds et al., 2013
Infectious disease caused by monkeypox virus and characterized by a severe rash, typically self-limiting, but can lead to severe illness or death. Death occurs in up to 11% of cases, most often in younger age groups.

Credit: WHO/M. V. Szczeniowski
Monkeypox occurs primarily around rainforests of West and Central Africa.

The natural host of monkeypox is not known.

Many species of small rodents and non-human primates are susceptible to monkeypox virus.

Following the eradication of smallpox, monkeypox virus emerged as the most significant orthopoxvirus in humans.
Monkeypox: The orthopoxviruses

- Like cowpox virus and variola virus (which causes smallpox), the monkeypox virus is a species of the genus *Orthopoxvirus* in the family *Poxviridae*.
- Monkeypox is a zoonosis (transmitted to humans from animals) with symptoms similar to smallpox, although less severe.
- Smallpox was eradicated in 1980 and vaccination ceased.
- Waning immunity may be a factor in the emergence of monkeypox.
Monkeypox: Virus characteristics

- Distinct virus subtypes group in two clades:
  - The **Central African** clade, prevalent in the Central African Republic, the Democratic Republic of the Congo and other countries.
    - Clinically, virus in this clade causes more severe illness and case fatality up to 11%
  - The **West African** clade, found in Nigeria, Côte d’Ivoire, Liberia and Sierra Leone.
    - This monkeypox virus causes less human-to-human transmission, less severe illness, and death in up to 6% of cases.

Credit: The Centers for Disease Control and Prevention (CDC), USA
History of monkeypox

- Monkeypox was first identified as an illness of non-human primates. The virus is also found in rodents.
- Monkeypox in humans was first identified in 1970 in the Democratic Republic of Congo.
- Democratic Republic of the Congo routinely reports a high number of cases: more than 1,000 suspected cases per year since 2005.

Credit: Exp Anim / C. Milhaud, et al., 1969
Since 2016, human monkeypox has been confirmed in:
- the Central African Republic,
- the Democratic Republic of the Congo,
- Liberia,
- Nigeria,
- the Republic of the Congo,
- Sierra Leone.

In 2018-19, cases were confirmed among travelers from Nigeria in:
- Israel,
- Singapore,
- the United Kingdom.
Monkeypox: Animal-to-human transmission

- Human infection has occurred from handling infected animals: giant poached rats, rope squirrels, and monkeys.
- Infection results from direct contact with the blood, bodily fluids, or external lesions of infected animals.
- Eating inadequately cooked meat of infected animals is a possible risk factor.
- For most human infections, the source is not known.
Animal species in Africa found to host monkeypox virus

- **Gambian pouched rat** *Cricetomys gambianus*
- **Dwarf dormouse** *Graphiurus murinus*
- **Sun squirrel** *Heliosciurus sp.*
- **Rope squirrel** *Funisciurus sp.*
- **Colobus monkey** *Colobus sp.*
- **Sooty mangabey** *Cercocebus atys*
- Human-to-human transmission results from close contact with infected respiratory droplets, skin lesions, or contaminated objects.
- Health care workers and household members of active cases are at higher risk of infection.
- As human-to-human transmission is limited, most outbreaks consist of only a few cases within families.
The interval from infection to onset of symptoms is usually 6 to 13 days, but can range from 5 to 21 days.
The infection progresses in two phases:

- the **invasion** period (0-5 days) characterized by fever, headache, lymphadenopathy (swelling of the lymph nodes), back pain, myalgia (muscle aches), and fatigue; and

- A characteristic **rash** appearing in stages 1-3 days after the onset of fever, beginning on the face and spreading to the trunk and limbs.

Credit: Nigeria Centre for Disease Control
Monkeypox: An evolving rash

- The rash lesions evolve from macules (lesions with a flat base) to papules (raised firm lesions) to vesicles (filled with clear fluid) to pustules (filled with yellowish fluid), followed by crusts.
- The rash affects:
  - the face in 95% of cases,
  - the palms and soles of the feet (75%),
  - oral mucous membranes (70%),
  - genitalia (30%),
  - the conjunctivae and cornea (20%).
- It may take three weeks for crusts to disappear.

Credit: CDC/ B. W. J. Mahy
- Lesions range from a few to several thousand and are often painful.
- Severe lymphadenopathy (swollen lymph nodes) is a distinctive feature of monkeypox and generally develops before the rash.
- Monkeypox usually lasts 3 to 4 weeks.
- Severe illness occurs more commonly in children.

Swollen lymph nodes
Credit: CDC/ B. W. J. Mahy
Monkeypox: Differential diagnosis

- Monkeypox can resemble other infectious illnesses with fever and rash, such as:
  - varicella (chickenpox)
  - measles
  - smallpox (now eradicated).
- Other conditions to ruled out:
  - bacterial skin infections, scabies, syphilis and medication allergies
- Early considerations include other febrile illnesses
- Laboratory confirmation is necessary to make a definitive diagnosis.
## Monkeypox: Clinical features

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Monkeypox</th>
<th>Chickenpox</th>
<th>Measles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fever</strong></td>
<td>Fever &gt; 38 °C, Rash after 1-3 days</td>
<td>Fever to 39 °C, Rash after 0-2 days</td>
<td>High fever to 40.5 °C, Rash after 2-4 days</td>
</tr>
<tr>
<td><strong>Rash appearance</strong></td>
<td>Macules, papules, vesicles, pustules present at the same stage on any area</td>
<td>Macules, papules, vesicles, present in several stages</td>
<td>Non-vesicular rash in different stages</td>
</tr>
<tr>
<td><strong>Rash development</strong></td>
<td>Slow, 3-4 weeks</td>
<td>Rapid, appear in crops over several days</td>
<td>Rapid, 5-7 days</td>
</tr>
<tr>
<td><strong>Rash distribution</strong></td>
<td>Starts on head; more dense on face and limbs; appears on palms and soles</td>
<td>Starts on head; more dense on body; absent on palms and soles</td>
<td>Starts on head and spreads; may reach hands and feet</td>
</tr>
<tr>
<td><strong>Classic feature</strong></td>
<td>Lymphadenopathy</td>
<td>Itchy rash</td>
<td>Koplik spots</td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td>Up to 11%</td>
<td>Rare</td>
<td>Varies widely</td>
</tr>
</tbody>
</table>

Note: Smallpox was eradicated in 1980. Clinically, smallpox was very similar to monkeypox. However, lymphadenopathy was not present in smallpox. Smallpox was more contagious and more often fatal.
Monkeypox can be confirmed in the laboratory.
The best specimens are from lesions (fluid, roof and crust).
The virus can be best identified with nucleic acid tests by PCR. Antigen and antibody detection methods are not specific.
Specimens from persons and animals should be handled by trained staff, wearing personal protective equipment and working in suitably equipped laboratories.
Procedures for safe storage and transport of samples must be followed.
Health care workers caring for patients or handling specimens must take standard, contact and droplet precautions:

- wash hands before and after caring for a patient, touching surroundings or handling specimens
- wear appropriate personal protective equipment including gowns, gloves, masks, goggles and boots
- ensure isolation of the patient in hospital or at home
- ensure proper waste disposal and environmental decontamination
- ensure safe and dignified burial.
Any person in contact with or taking care of a person with monkeypox should:
- avoid close contact
- wear gloves and other protective equipment
- always wash hands before and after caring for or visiting sick persons.
Case management is based on symptom-specific, supportive care.

First generation vaccinia vaccines used to prevent smallpox also largely protected vaccinees from monkeypox.

In 2019, a newer vaccinia vaccine for smallpox was also approved for prevention of monkeypox in adults.

Further vaccination and treatment studies are underway.
Countries at risk should include monkeypox in their integrated disease surveillance and response system.

The goal is to detect and immediately respond to any suspected case of monkeypox.

Develop case definitions: e.g. a suspected case may be an acute illness with fever > 38 °C, intense headache, lymphadenopathy, back pain, myalgia, and intense fatigue followed one to three days later by a progressively developing rash on the face and spreading to the body, palms of hands and soles of feet.

Safely collect patient information and lesion samples from every suspected case for laboratory testing.
Monkeypox: Outbreak response

- Each suspected or confirmed case of monkeypox requires immediate response.
- Report all case information to health authorities.
- Initiate outbreak coordination.
- Put in place laboratory confirmation, contact tracing, active search, rumour tracking, and enhance surveillance.
- Initiate community education and risk communication.
- Institute infection prevention and control measures in all situations.
Focus health education on measures to reduce exposure:
- understand the risk of handling or consuming wild animals and avoid contact.
- wear gloves and other protective clothing to handle or slaughter animals.
- avoid close contact with patients during human monkeypox outbreaks.
WHO and partners are working to improve understanding and control of monkeypox
  - One Health approach
- Early detection and diagnostics:
  - clinical knowledge;
  - laboratory capacity.
- Better capacity for disease control:
  - coordinating global expertise
  - vaccines and treatments.
Monkeypox: Key messages

- Monkeypox is an emerging disease
- Monkeypox can be seen in endemic countries or anywhere in the world
- Report any suspected case
- Take all precautions to prevent spread
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