

MONKEYPOX: AN AFRICAN VIRUS EMERGING OUTSIDE AFRICA

Prof.Dr.Ali Mohamed Zaki

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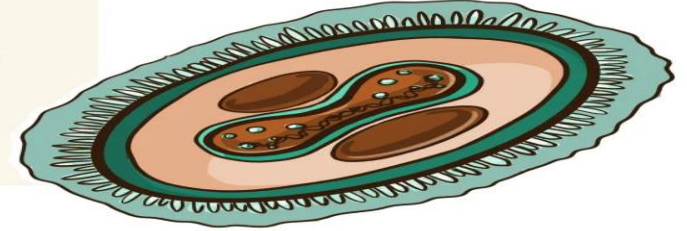
11/4/2022

- **EPIDEMIOLOGY AND HISTORICAL OUTBREAKS**
- **VIROLOGY**
- **CLINICAL PRESENTATION**
- **DIAGNOSIS**
- **CLINICAL MANAGEMENT**
- **Cidofovir, Brincidofovir, Tecovirimat, Vaccinia Immune Globulin Intravenous**
- **IMMUNIZATION**
- **Use of Immunization as Pre-Exposure or Postexposure Prophylaxis**
- **CONTACT TRACING, ISOLATION, AND WASTE MANAGEMENT**

ABSTRACT

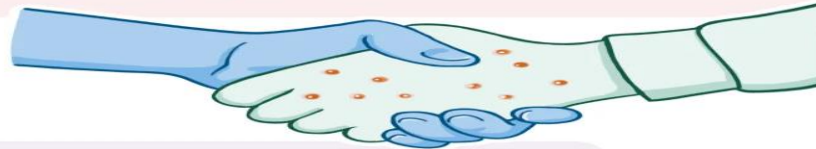
BACKGROUND

- * **VIRAL INFECTIOUS DISEASE** that **CAUSES** a **FEBRILE ILLNESS** with **CHARACTERISTIC SKIN RASH & SWOLLEN LYMPH NODES**
- ~ SYMPTOMS SIMILAR to **SMALLPOX** but **CLINICALLY LESS SEVERE**
- ~ **DISCOVERY** in **1958** with **2 OUTBREAKS** of **POX-LIKE DISEASE** in **COLONIES** of **MONKEYS** KEPT for **RESEARCH**
- ~ **FIRST HUMAN CASE** REPORTED in **DEMOCRATIC REPUBLIC** of **CONGO** in **1970**



CAUSES

- * **INFECTION** with **MONKEYPOX VIRUS**
- ~ **CONTACT** with **INFECTED PERSON** or **ANIMAL**
 - **ROPE SQUIRRELS, TREE SQUIRRELS, GAMBIAN POUCHED RATS, DORMICE, MONKEYS**
- **CLOSE CONTACT** with **INFECTED SKIN LESIONS**
- **BODILY FLUIDS**
- **RESPIRATORY DROPLETS**
- **CONTAMINATED OBJECTS (CLOTHING, TOWELS, BEDDING)**
- **MOTHER** to **FETUS** via **PLACENTA** or **DURING/ AFTER** **CHILDBIRTH**

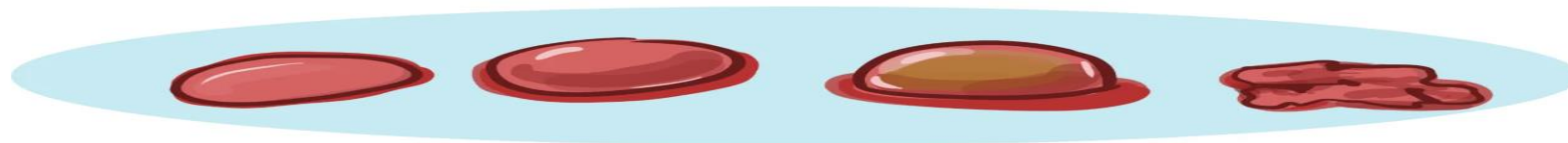


DIAGNOSIS

- * **PCR TESTING**
- ~ **ANTIBODY TESTING INCONCLUSIVE**

SIGNS & SYMPTOMS

- * **INCUBATION PERIOD: 6 - 14 DAYS**
- ~ **CAN RANGE** from **5 - 21 DAYS**
- * **INITIAL:**
- ~ **FEBRILE ILLNESS: FEVER, CHILLS, INTENSE HEADACHE, SWELLING of LYMPH NODES, BACK PAIN, MUSCLE ACHES, LACK of ENERGY**
- * **WITHIN 3 DAYS of FEVER:**
- ~ **CHARACTERISTIC RASH: FLAT RED BASE** that **EVOLVES** into **SLIGHTLY RAISED FIRM LESIONS**
- ~ **LESIONS** eventually **CHANGE** to **VESICLES** **FILLED** with **YELLOW FLUID**, then **CRUST OVER & SLOUGH OFF**



CHARACTERISTIC RASH/LESIONS

TREATMENT

- * **CURRENTLY NO SPECIFIC TREATMENTS**
- * **SEVERE ILLNESS** or **RISK** of **COMPLICATION:**
- ~ **ANTIVIRALS: TECOVIRIMAT (TPOXX), CIDOFOVIR (VISTIDE), BRINCIDOFOVIR (TEMBEXA), VACCINIA IMMUNE GLOBULIN INTRAVENOUS (VIGIV)**
- * **SMALLPOX VACCINE**
- ~ **35% PROTECTION** from **GETTING MONKEYPOX**
- ~ **VACCINATION AFTER EXPOSURE** MAY **HELP PREVENT** **GETTING** or **REDUCE SEVERITY**



1958 IN NONHUMAN PRIMATES

- A once-neglected zoonotic virus endemic to West and Central Africa, monkeypox virus was first identified in 1958 in nonhuman primates kept for research in Denmark

MONKEYPOX CAN FILL THE NICHE LEFT VACANT BY SMALLPOX ERADICATION.

- Ecologic and epidemiologic limits that could impede monkeypox's emergence
- Genetic constrains that may hamper monkeypox from becoming a human-adapted virus

Rotterdam zoo

Orangutan: *Pongo pygmaeus*

Asian gibbon: *Hylobates lar*

Giant ant-eater: *Myrmecophaga tridactyla*

South American squirrel monkey: *Saimiri sciureus*

South American common marmoset: *Hapale jacchus*

African gorilla: *Gorilla gorilla*

Chimpanzee: *Pan troglodytes*

African owl-faced monkey: *Cercopithecus hamlyni*

Prairie dog: *Cynomys spp.*

Rope squirrel: *Funisciurus aneurithrus*

Gambian-pouched rat: *Cricetomys sp.*

African dormouse: *Graphiurus sp.*

Four-toed shrew: *Petrodomus tetradactylus*

Gambian squirrel: *Heliosciurus sp.*

Atherurus sp.

Striped mouse: *Hybomys sp.*

Rhesus monkey: *Macaca mulatta*

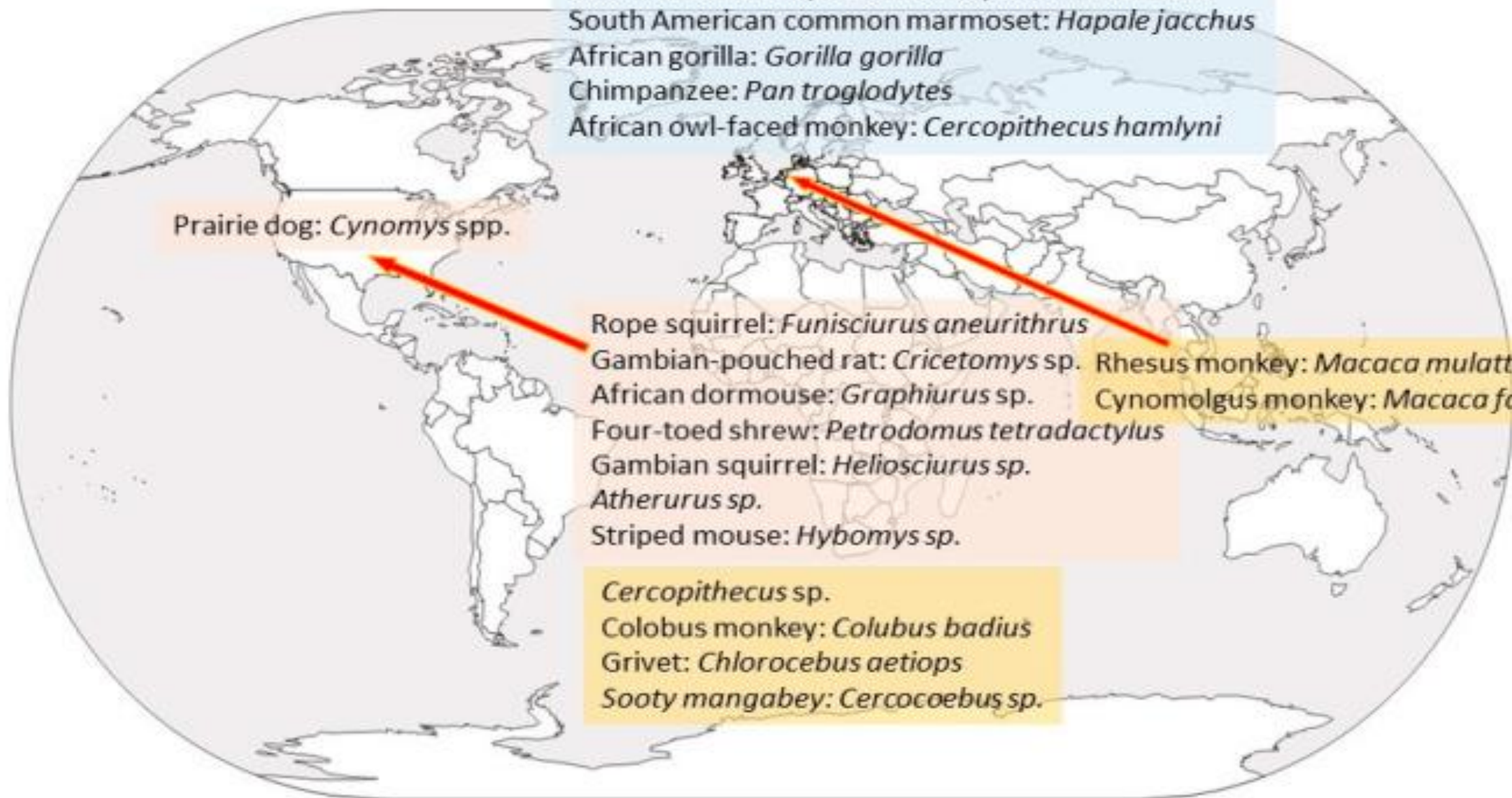
Cynomolgus monkey: *Macaca fascicularis*

Cercopithecus sp.

Colobus monkey: *Colobus badius*

Grivet: *Chlorocebus aetiops*

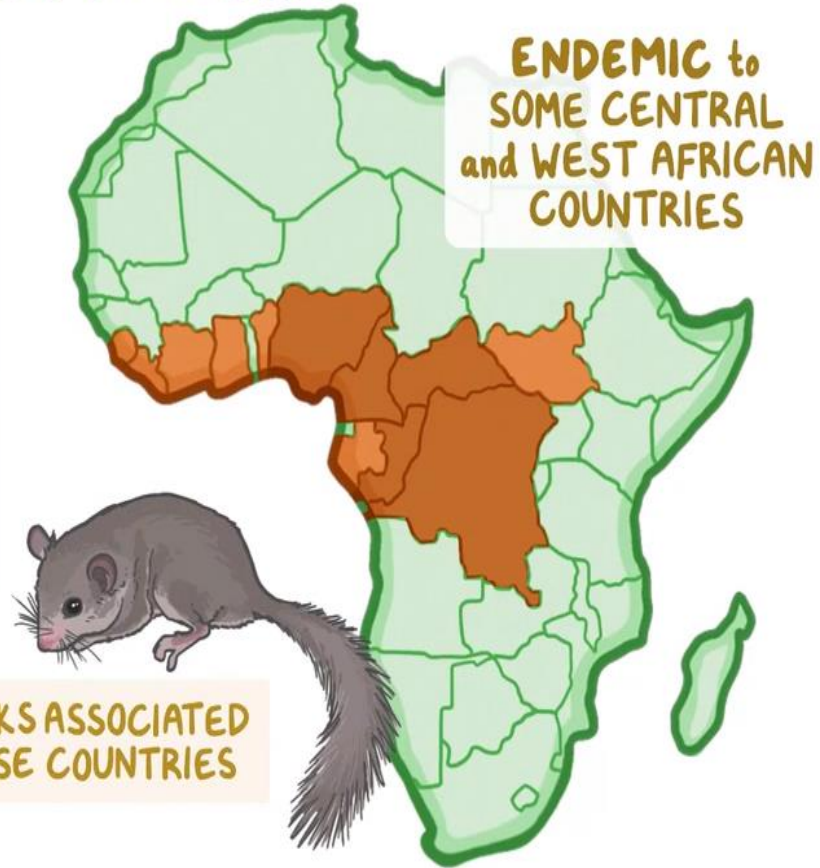
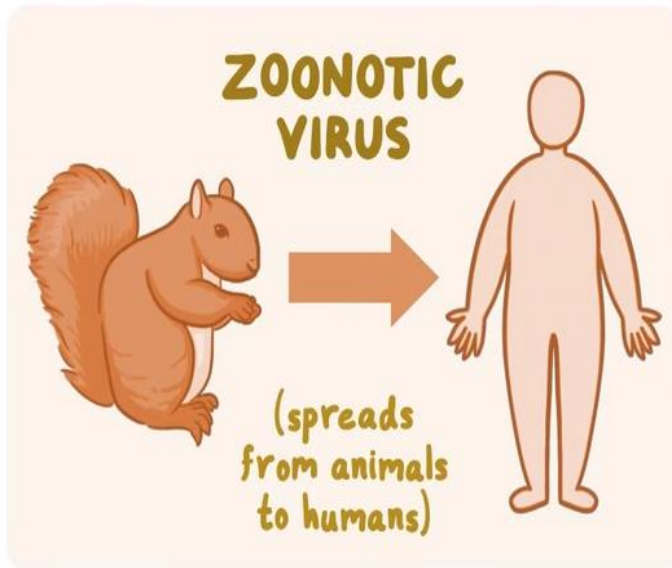
Sooty mangabey: *Cercocoebus sp.*



- Seen from left to right, a rope squirrel, an African Tree Squirrel, a Gambian Poached rat, & the Samango Monkey (an example of a West African Monkey). In the bottom left corner, that's a little dormouse.

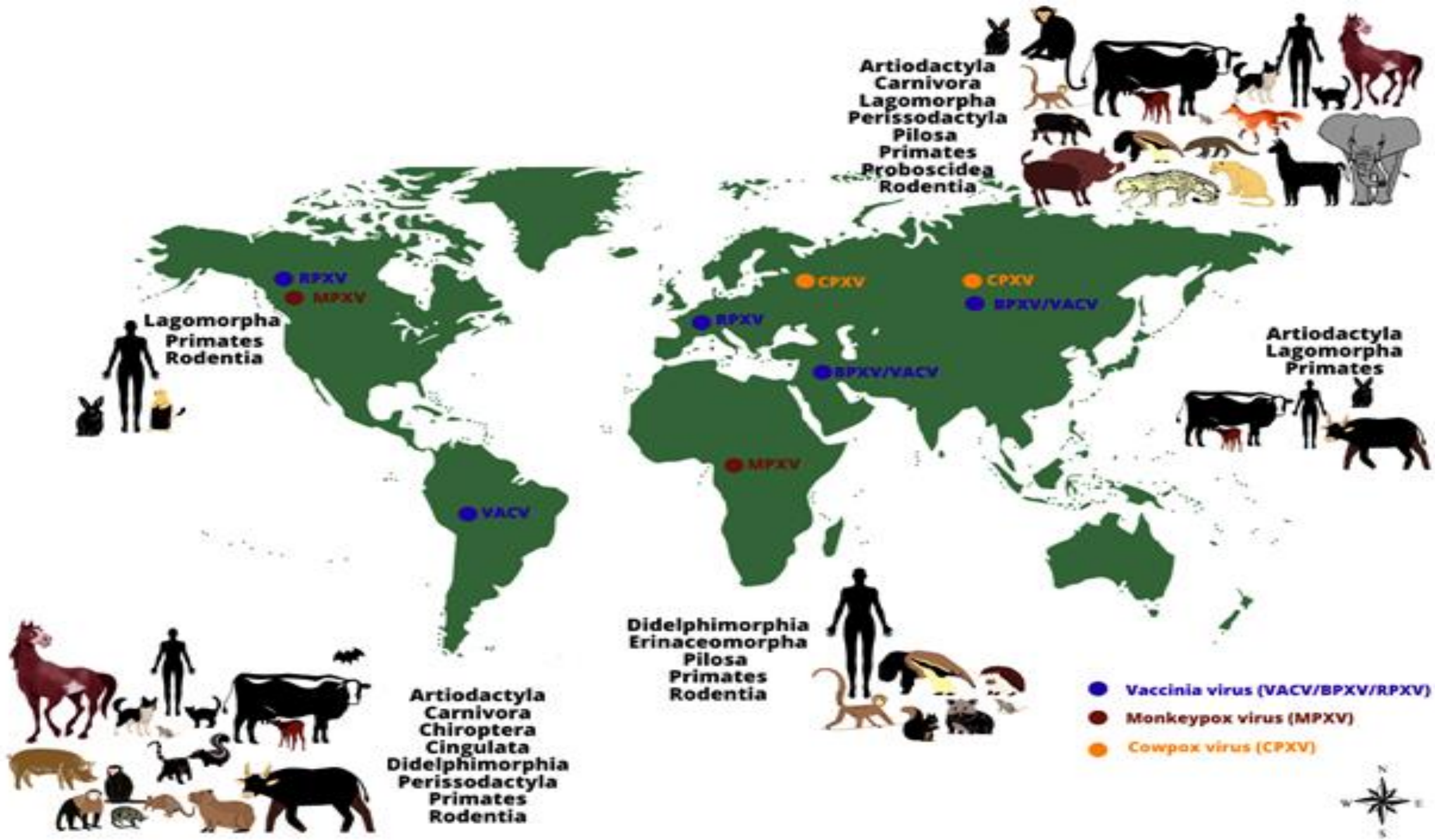


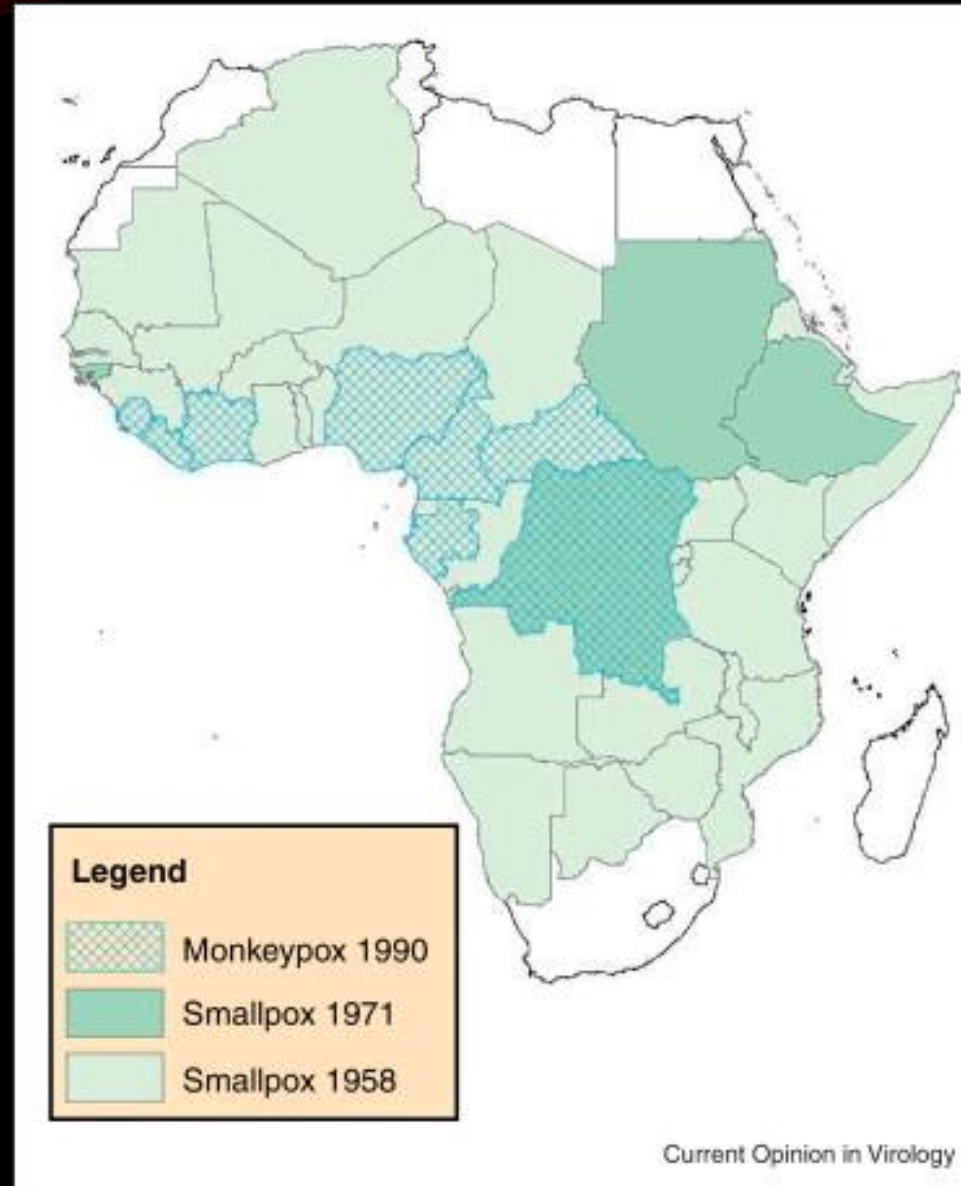
EPIDEMIOLOGY

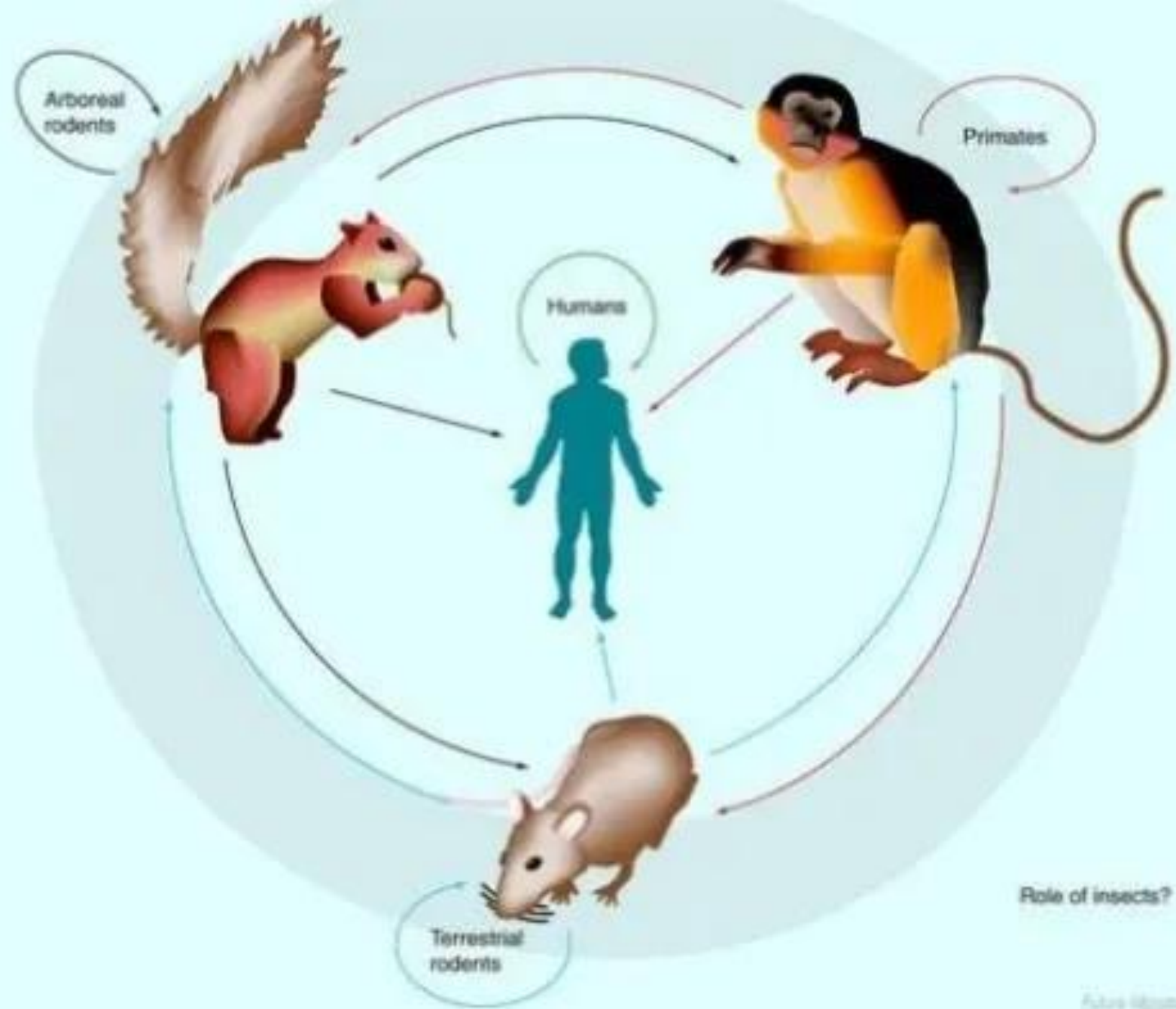


* OCCASIONAL GLOBAL OUTBREAKS ASSOCIATED with ANIMALS TRADED from THESE COUNTRIES

- Species that have been found to be positive, either by virus isolation or presence of antibodies, and area of origin. Rodents are written in pink boxes; non-human primates in orange boxes and the species that were affected at the Rotterdam Zoo in a blue box.







MONKEYPOX

HOW IT SPREADS

➤ **Primarily animals, typically rodents**



Bites



Scratches



Consumption of bush meat



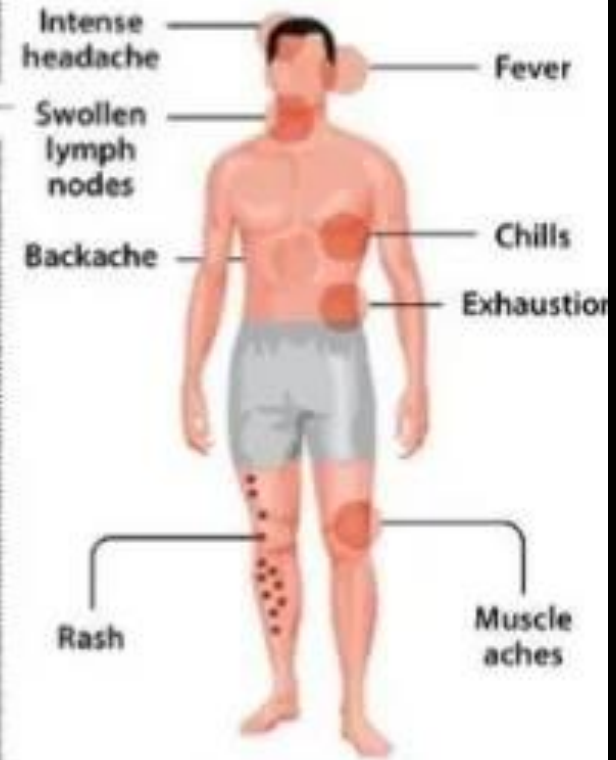
➤ **Human-to-human transmission is possible, but limited**

Through close contact with infected respiratory tract secretions or skin lesions



Monkeypox Cell

SYMPTOMS



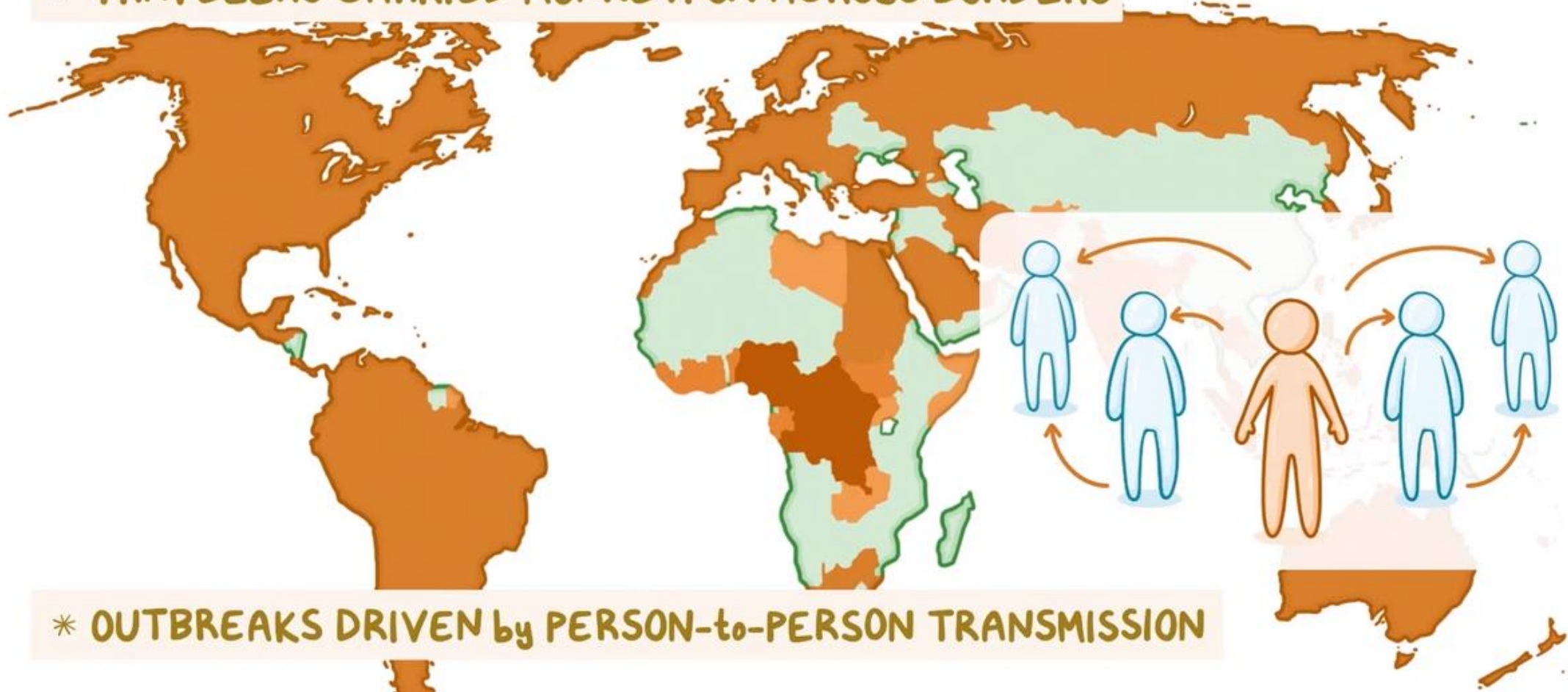
Illness lasts for 2-3 weeks



Infographic by Refa Estrada Source: Singapore Ministry of Health, US Centers for Disease Control and Prevention

In 2022...

* TRAVELERS CARRIED MONKEYPOX ACROSS BORDERS



* OUTBREAKS DRIVEN by PERSON-to-PERSON TRANSMISSION

TRANSMISSION

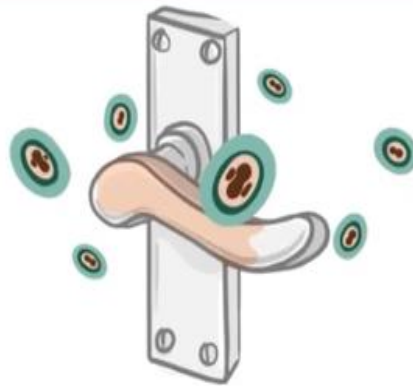
* **DIRECT CONTACT** with **SKIN LESIONS, BODILY FLUIDS,** and **RESPIRATORY SECRETIONS** of **INFECTED INDIVIDUALS**

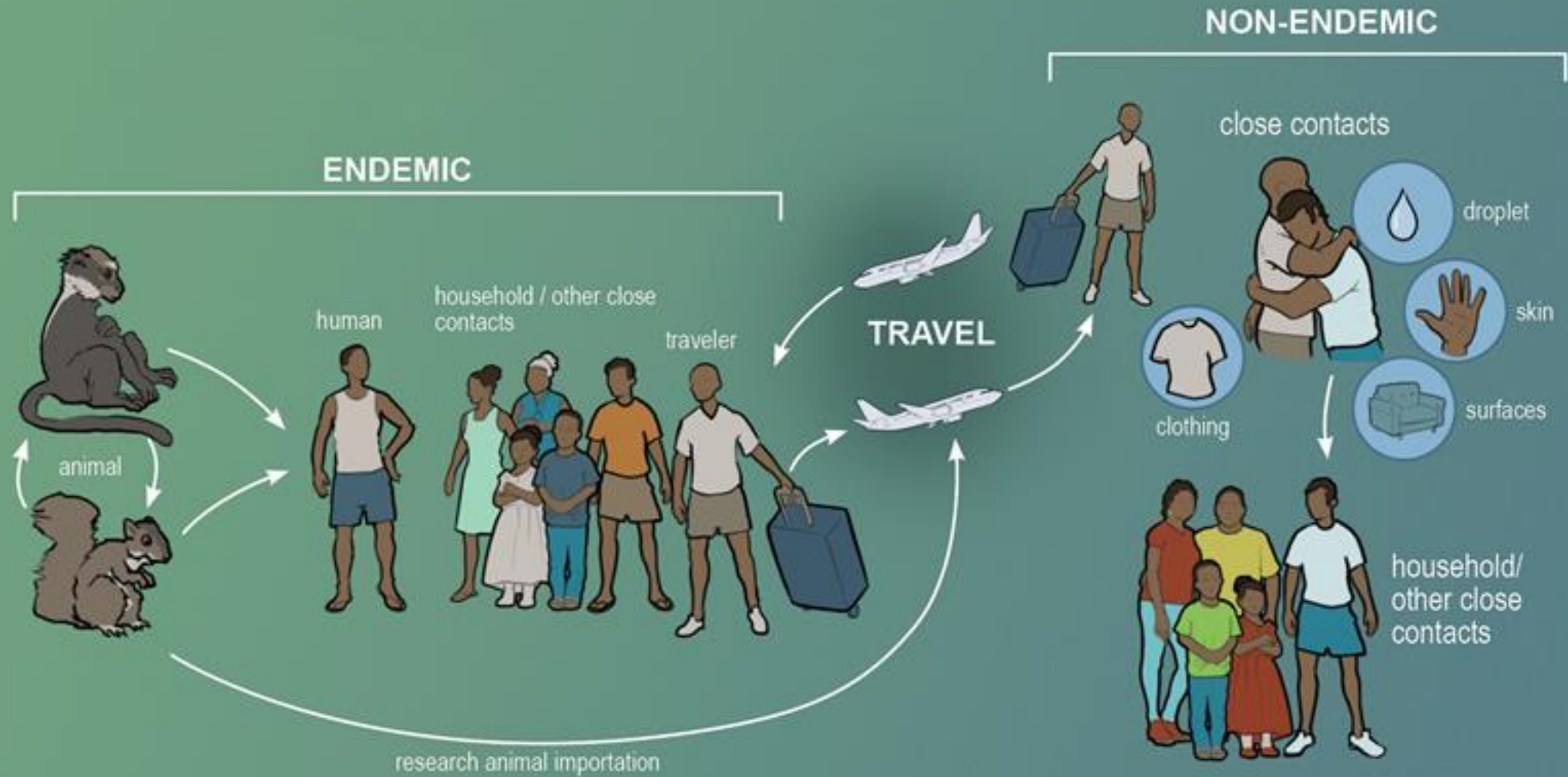


* Also **SPREAD** to **FETUS** THROUGH **PLACENTA**



* **CONTAMINATED OBJECTS, FABRICS, and SURFACES**





Michael Konomos ©2022 Emory University

HUMAN CASES

- 1970
- 2003
- 2022

- **On May 14, 2022**, a familial cluster of 2 cases of monkeypox was reported in the UK; the case-patients had no history of travel to an endemic region. Since then, thousands of cases have been reported in multiple countries in Europe, South America, the Middle East, Canada, and the United States

TOTAL NUMBER OF CASES

- Since May 2022
- The total number of confirmed cases
77200
- Total Deaths
36



ELSEVIER

Vaccine

Volume 38, Issue 33, 14 July 2020, Pages 5077-5081



Conference report

Human monkeypox – After 40 years, an unintended consequence of smallpox eradication

Karl Simpson ^a  , David Heymann ^b , Colin S. Brown ^c , W. John Edmunds ^b , Jesper Elsgaard ^d , Paul Fine ^b , Hubertus Hechrein ^e , Nicole A. Hoff ^f , Andrew Green ^g , Chikwe Ihekweazu

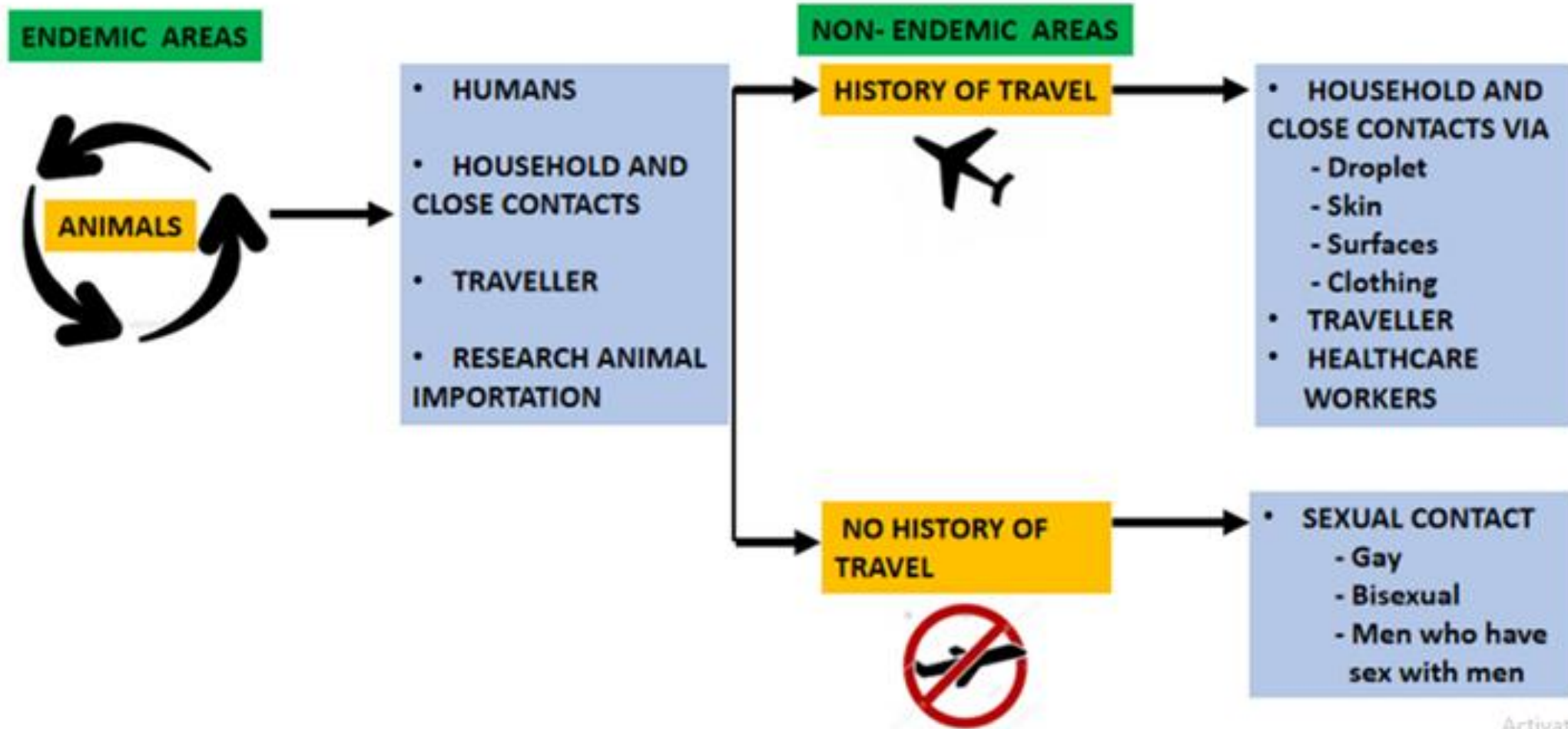


Figure 1. Depicts various modes of transmission for monkeypox infection.

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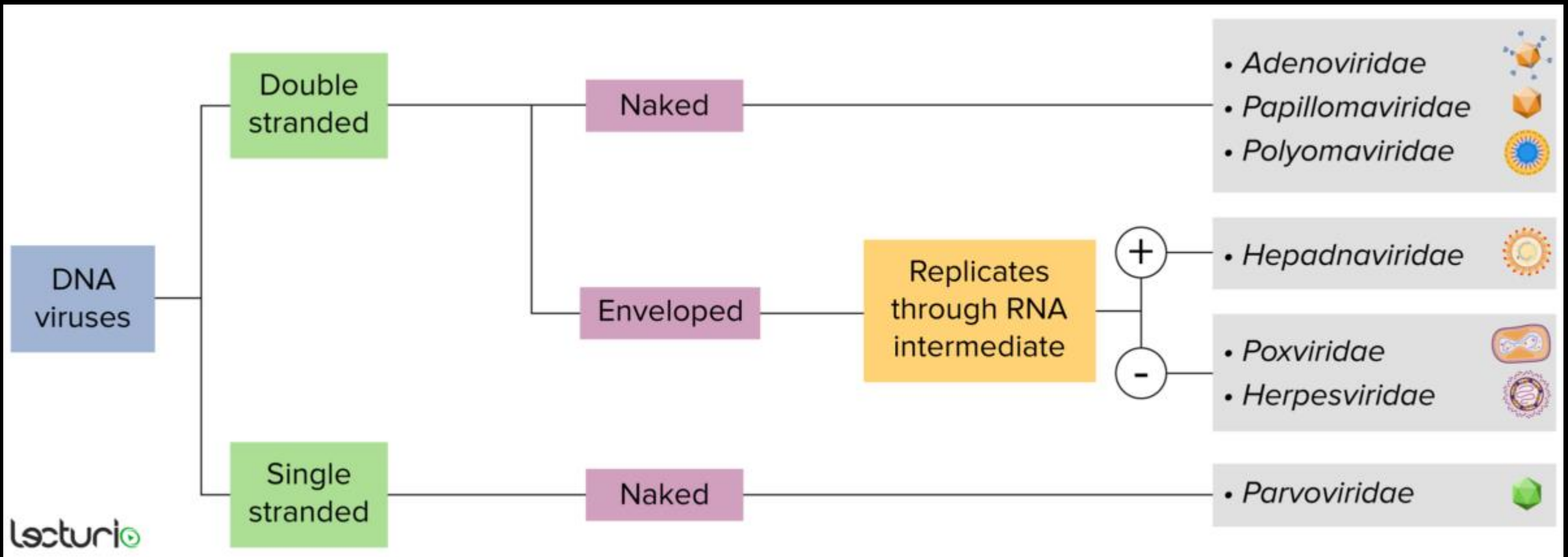


Emergence of Monkeypox as the Most Important Orthopoxvirus Infection in Humans

Nikola Sklenovská and Marc Van Ranst*

Laboratory of Clinical Virology, Department of Microbiology & Immunology, Rega Institute for Medical Research, KU Leuven, Leuven, Belgium

ORTHOPOX VIRUSES



Betaentomopoxvirus (Amsacta moorei entomopoxvirus 'L')

Avipoxvirus (Fowlpox virus)

Molluscipoxvirus (Molluscum contagiosum virus)

Parapoxvirus (Orf virus)

Yatapoxvirus (Yaba monkey tumor virus)

Leporipoxvirus (Myxoma virus)

Cervidpoxvirus (Deerpox virus)

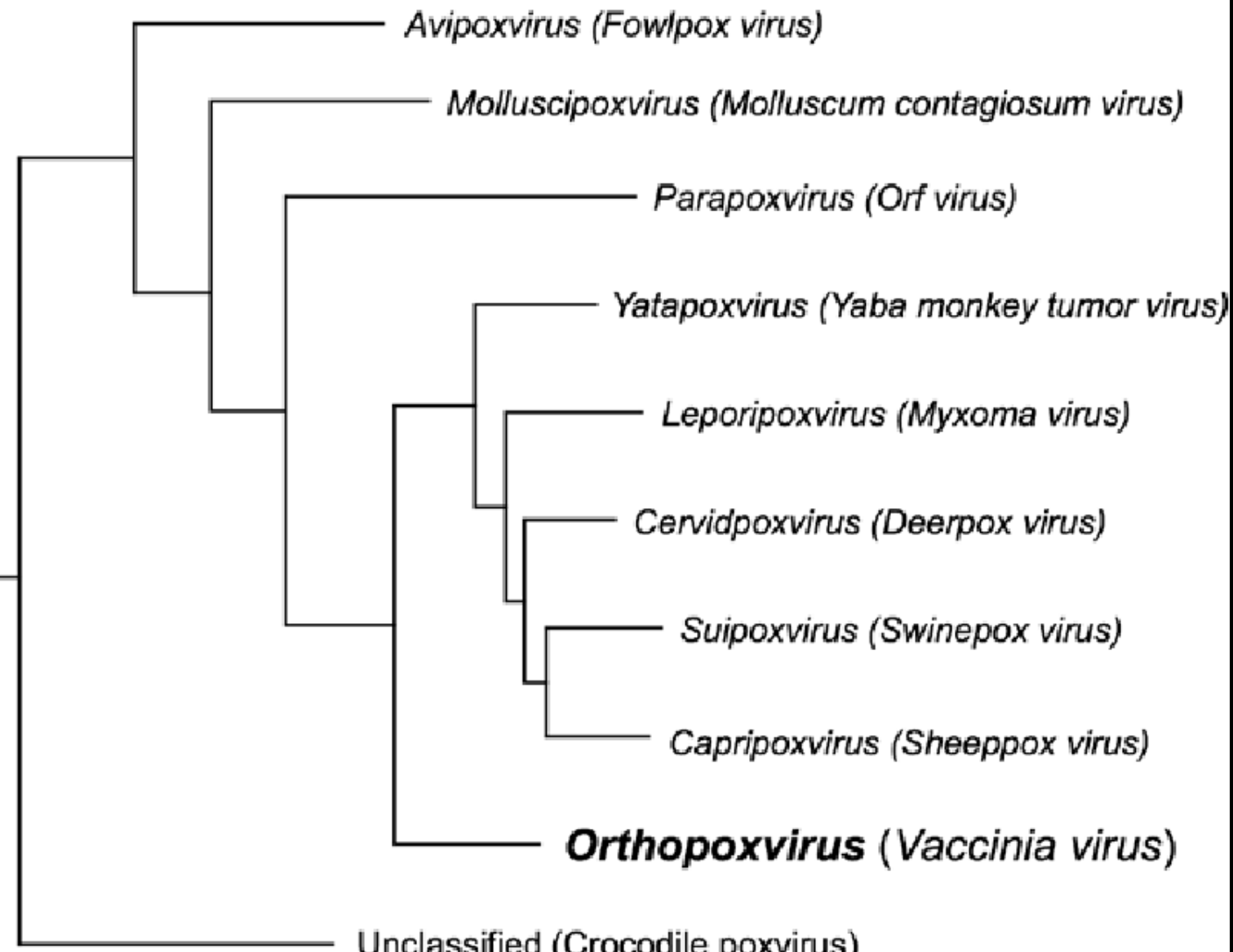
Suipoxvirus (Swinepox virus)

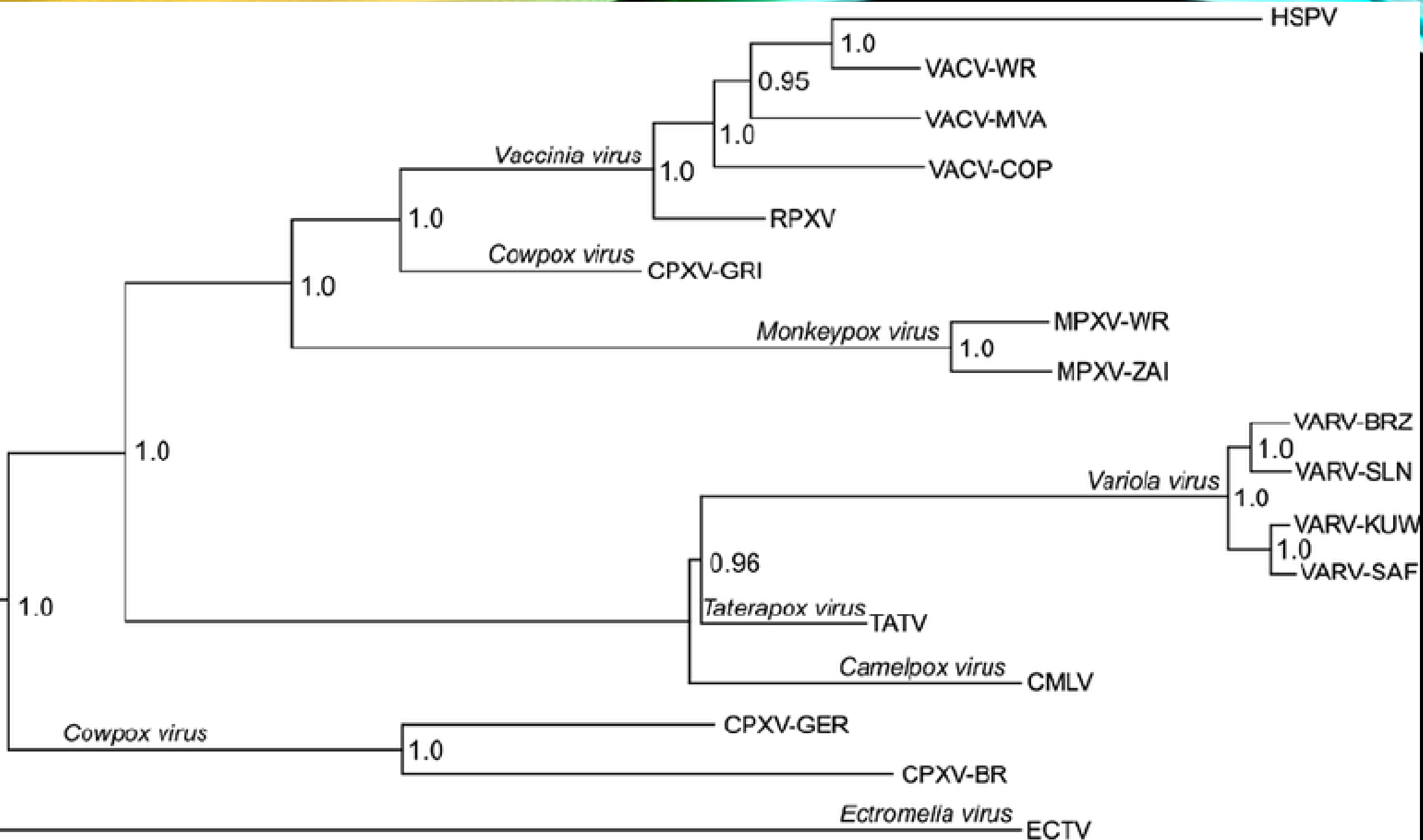
Capripoxvirus (Sheeppox virus)

Orthopoxvirus (Vaccinia virus)

Unclassified (Crocodile poxvirus)

Chordopoxvirinae







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ELSEVIER

Current Opinion in Virology

Volume 2, Issue 3, June 2012, Pages 335-343



Factors affecting the likelihood of monkeypox's emergence and spread in the post-smallpox era ☆

Mary G Reynolds✉, Darin S Carroll, Kevin L Karem

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Part of special issue:

Viral pathogenesis/Vaccines

Edited by Diane Griffin, Veronika von Messling, Christian Mandl, Connie Schmaljohn

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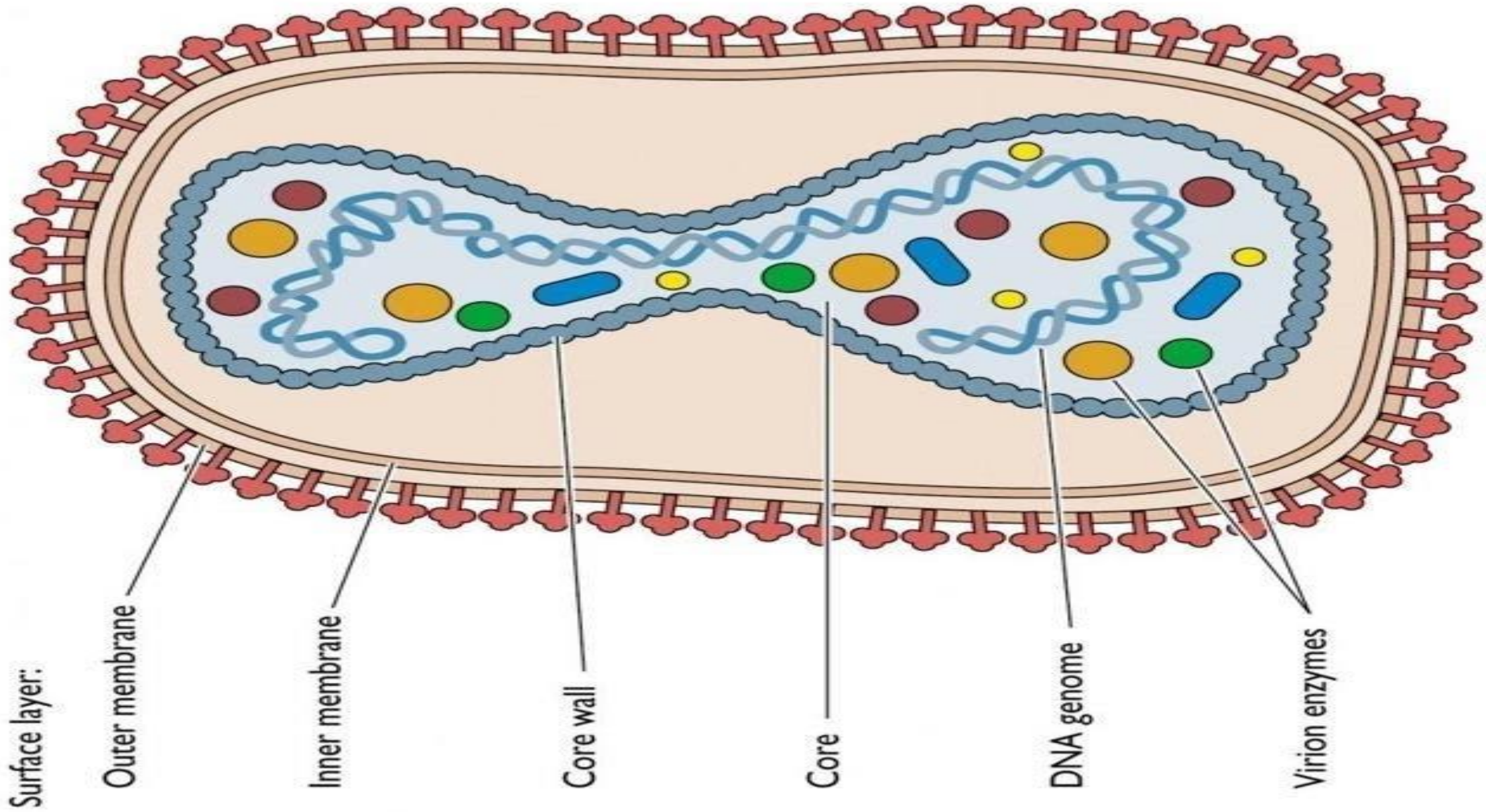
The mucosal immune system of the resp...
June 2012, pp.

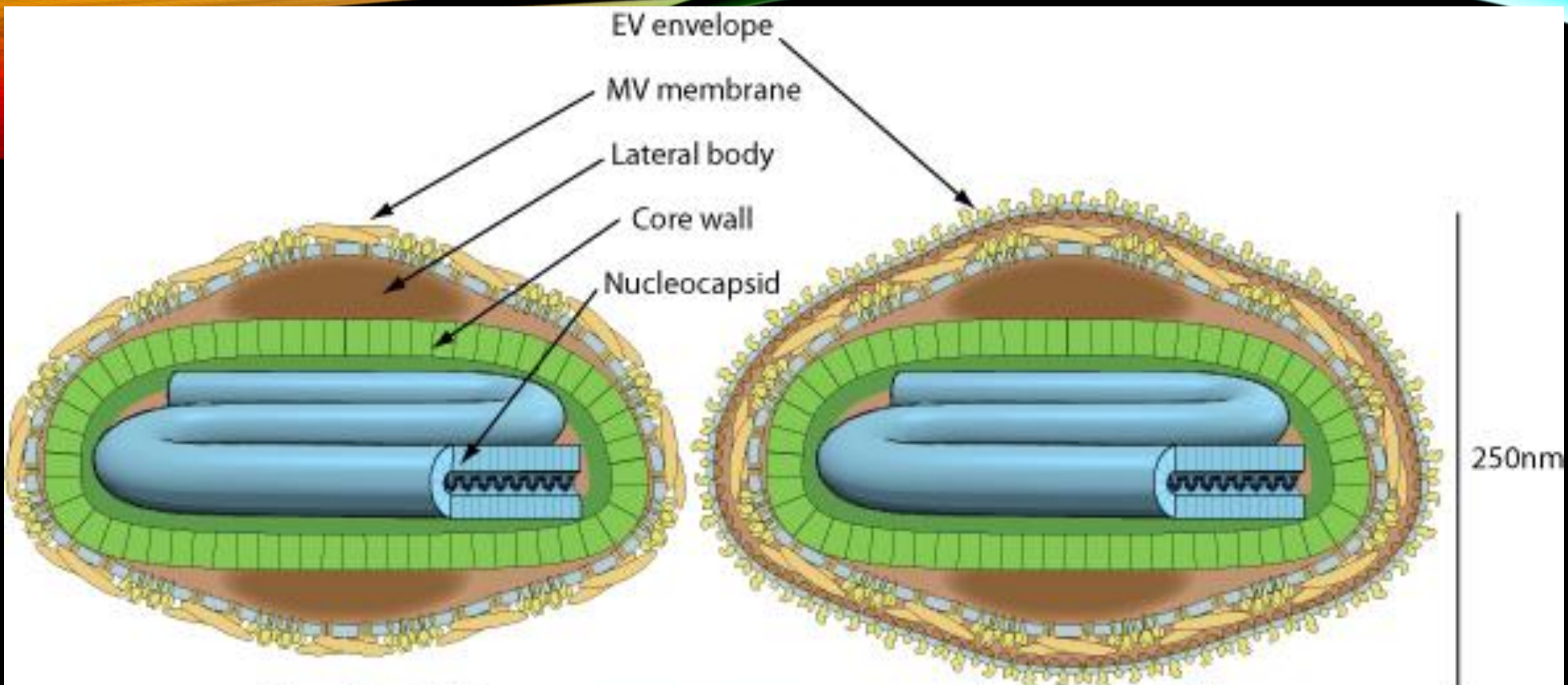
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FEEDBACK
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VIRUS

- Enveloped, brick-shaped virion, 250nm long and 200nm wide. The surface membrane displays surface tubules or surface filaments. Two distinct infectious virus particles exists: the intracellular mature virus (IMV) and the extracellular enveloped virus (EEV).
- **GENOME**
- Linear, dsDNA genome of 170-250kb. The linear genome is flanked by inverted terminal repeat (ITR) sequences which form covalently closed hairpin termini at each extremity.





Mature Virion (MV)

© ViralZone 2014
Swiss Institute of Bioinformatics

Enveloped Virion (EV)

360nm

GENOMIC VARIABILITY OF MONKEYPOX VIRUS AMONG HUMANS, DEMOCRATIC REPUBLIC OF THE CONGO

- genome diversity of viruses in 60 samples obtained from humans
- **detected 4 distinct lineages** and a deletion that resulted in gene loss in 10 (16.7%) samples and that seemed to correlate with human-to-human transmission ($p = 0.0544$).
- The data suggest a high frequency of spillover events from the pool of viruses in nonhuman animals,
- The potential for accelerated adaptation to humans should be monitored through improved surveillance.

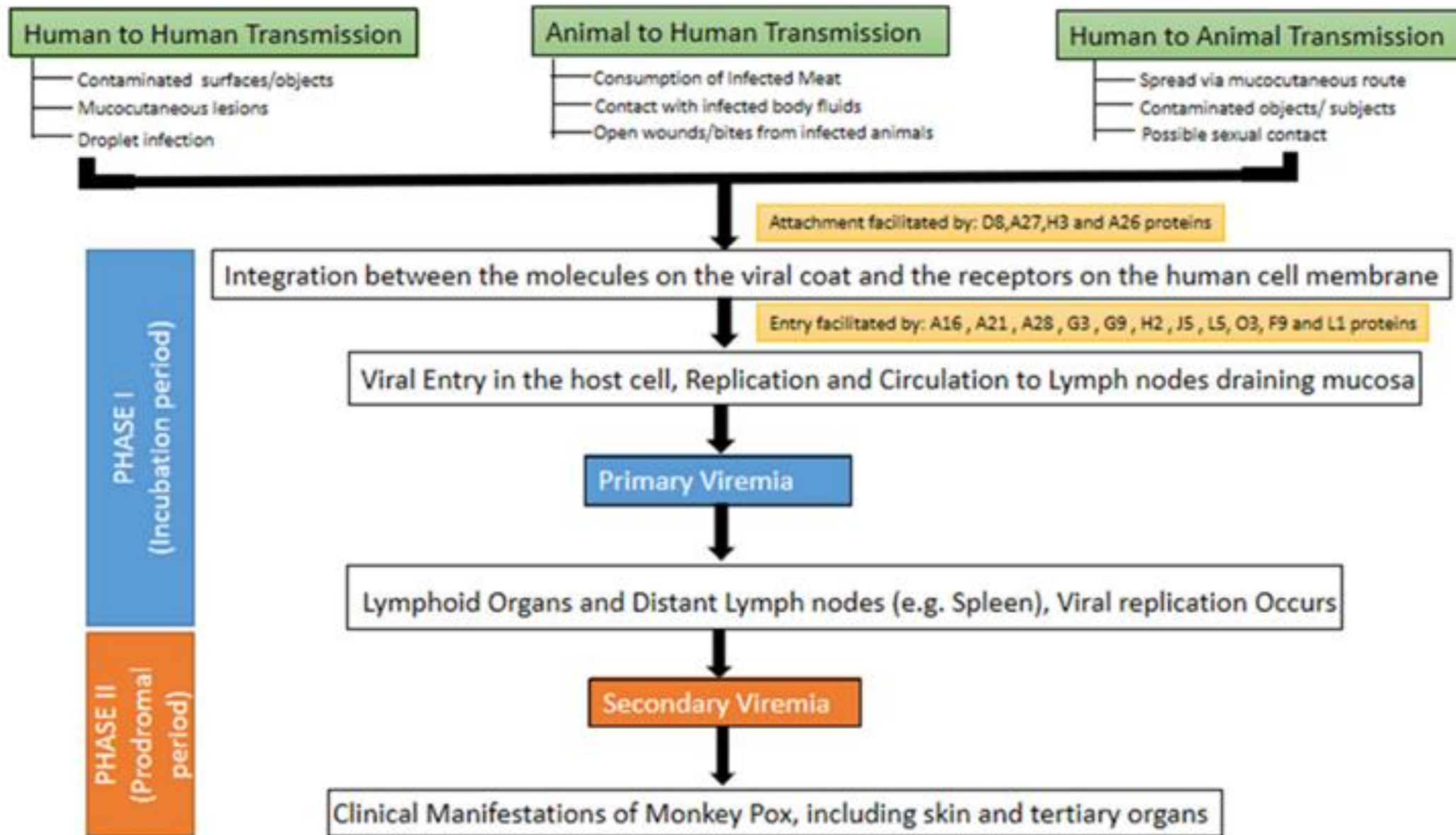


Figure 3. Pathogenesis of monkeypox virus infection.

RE-EMERGENT MONKEYPOX IN AFRICA

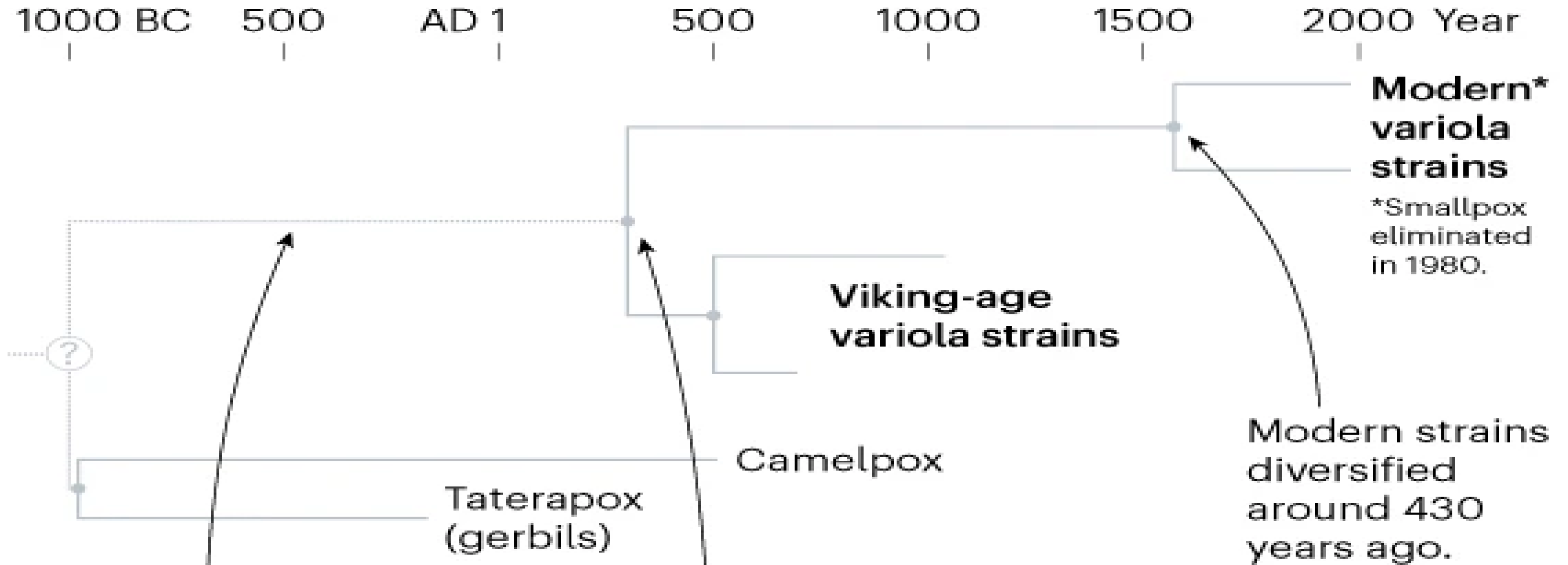
- Hypothesised factors in the **emergence or re-emergence of monkeypox disease include**
- Climate change
- Rain Forest exploitation
- Geopolitical and armed conflicts in disease areas
- Highly mobile populations
- **Waning herd immunity, following cessation of smallpox vaccination.**

- تغير المناخ
- استغلال الغابات المطيرة
- النزاعات الجيوسياسية والمسلحة في مناطق المرض
- عدد كبير من السكان متنقل
- تناقص مناعة القطيع بعد التوقف عن التطعيم ضد الجدري.

- SMALLPOX: THE ORIGIN OF A DISEASE
- VARIOLATION AND EARLY ATTEMPTS OF TREATMENT

ANCIENT SMALLPOX

The discovery of variola virus, which causes smallpox, in Viking-era remains shows that the disease has been present in humans for at least 1,700 years.



Unknown animal virus jumps into humans, giving rise to human variola; timeline uncertain.

Variola found in Viking-era remains might have shared a common ancestor with modern strains around 1,700 years ago.

- **Historical accounts and lesions found on Egyptian mummies suggest that the *Variola* virus, which causes smallpox, has plagued people for thousands of years**



THE VIKING AGE

- The DNA of ancient smallpox viruses has been found in the bones and teeth of a dozen or so people who lived in northern Europe during the Viking age. Unexpectedly, these smallpox strains are quite different to the strain that was eliminated in the 20th century – and possibly far less deadly.

DNA FROM VIKING PEOPLE REVEALS THE UNEXPECTED HISTORY OF SMALLPOX

39





1689–1762

INTRODUCED SMALLPOX INOCULATION

Lady Mary Wortley Montagu defied convention by introducing smallpox inoculation into Western medicine. While visiting the Ottoman Empire, she learnt about Turkish customs and witnessed the practice of inoculation against smallpox.

Lady Mary was eager to spare her children the suffering of smallpox, so in 1718 she had her nearly five-year-old son, Edward, inoculated.

On her return to London, she promoted the procedure, despite resistance from the medical establishment.

INOCULATED SON AGAINST SMALLPOX ALMOST 80 YEARS BEFORE JENNER'S VACCINE





- Lady
- Mary
- Wortley
- Montague (1689–1762)





EMBARQUEMENT DES FRAGMENTS ANTIQUES ENVOYES EN FRANCE, RECUEILLIS EN GRECE PAR M. LA C^{te} DE GEORGIADIS-GOUFFERET
Ambassadeur de France, pour la Porte-Ottomane, en 1769.



SMALLPOX AND VACCINATION

[Proc \(Bayl Univ Med Cent\)](#). 2005 Jan; 18(1): 21–25. doi: [10.1080/08998280.2005.11928028](https://doi.org/10.1080/08998280.2005.11928028)

PMCID: PMC1200696 | PMID: [16200144](https://pubmed.ncbi.nlm.nih.gov/16200144/)

Edward Jenner and the history of smallpox and vaccination

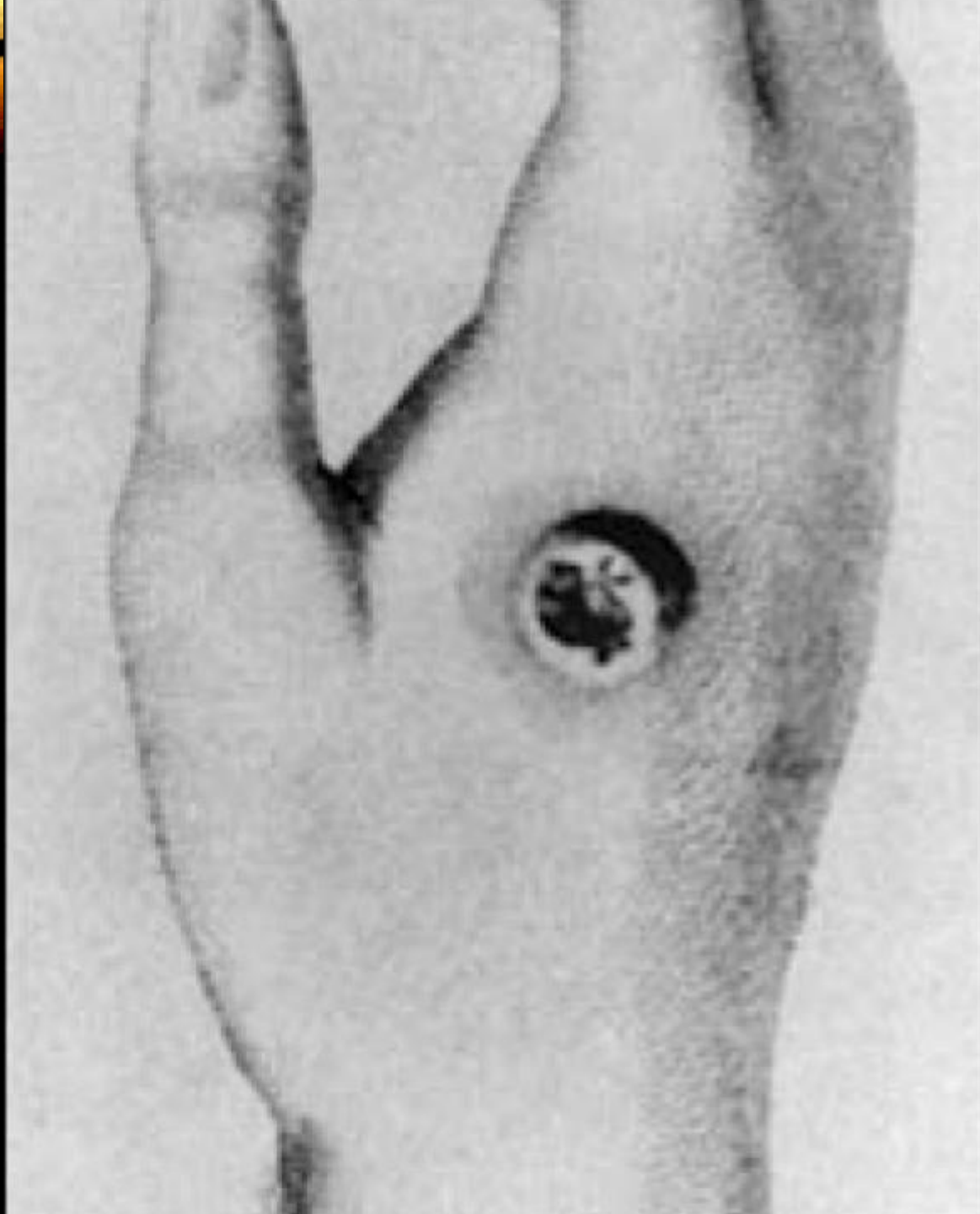
[Stefan Riedel](#), MD, PhD¹

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- The world and all its people have won freedom from smallpox, which was the most devastating disease sweeping in epidemic form through many countries since earliest times, leaving death, blindness and disfigurement in its wake









- **The Temple of Vaccinia**







Current Opinion in Virology



- The first case in humans was reported in **1970 in the Democratic Republic of Congo** . Over the past 50 years, sporadic outbreaks have been reported mainly in African countries, with several thousand human cases recorded to date.

NONENDEMIC COUNTRIES

- Occasional cases and limited outbreaks linked to travel or importation of animals harboring the virus have also been described in nonendemic countries .

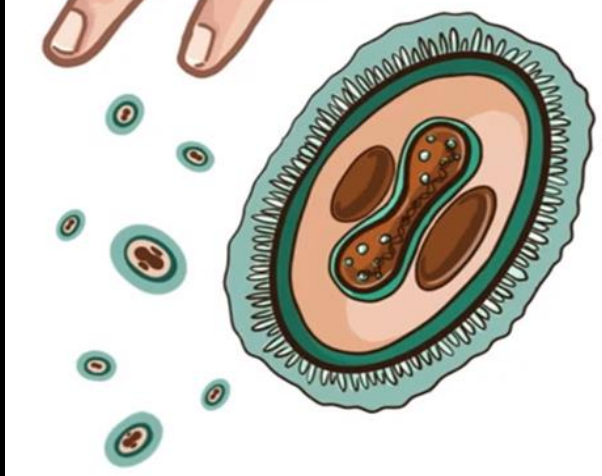
- The combined effects of deforestation, population growth, encroachment on animal reservoir habitats, increasing human movement, and enhanced global interconnectedness have made this possibility more real in the last 20 years

- With increasing case numbers being reported in the current outbreak, it is important for clinicians everywhere to update their knowledge of this zoonotic infection, including its prevention, clinical management, prophylaxis, and basics of infection control, to understand the broader implications of the current outbreak.



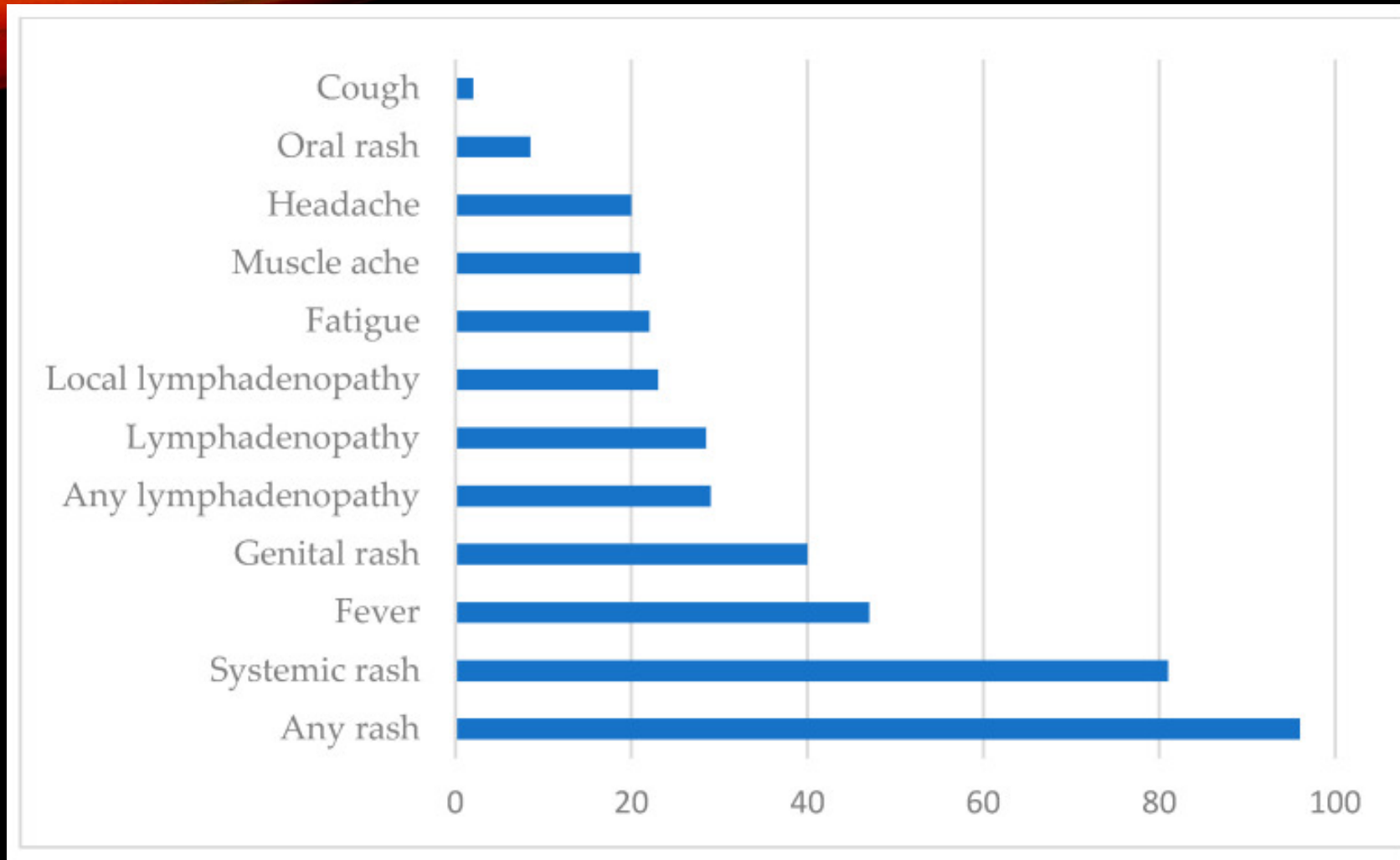
MONKEYPOX

A DISEASE CAUSED by the **MONKEYPOX VIRUS**



* **GIVEN** the **NAME** **BECAUSE** it was **SEEN** in **CAPTIVE MONKEYS**

(Discussions are underway regarding renaming the virus)



SIGNS & SYMPTOMS

* USUALLY BEGIN 6 to 14 DAYS AFTER VIRUS ENTERS BODY

- FEVERS



- CHILLS



- HEADACHE



- MUSCLE ACHES



- BACK PAIN



- LACK of ENERGY

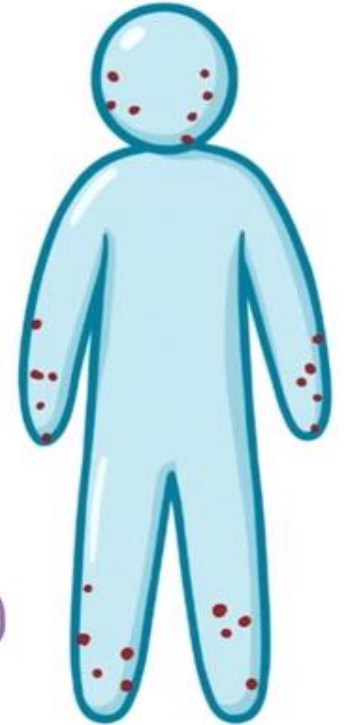
- SWOLLEN LYMPH NODES



After a couple of days...

* RASH with FIRM, WELL-CIRCUMSCRIBED LESIONS on SKIN and/or MUSCOSAL MEMBRANES

(Rash may be the only symptom)



FLAT
MACULES



→ UMBILICATED
PUSTULES



→ CRUSTING,
HEALING



Table 1. Delineates the various diagnostic aids for monkeypox virus infection.

Diagnostic Tests	Description	Specimen Used
Polymerase chain reaction (PCR)	It is based on the nucleic acid amplification test (NAAT) that demonstrates monkeypox DNA (deoxyribonucleic acid); real-time PCR is currently the gold standard.	Lesion exudate/crust sample
Viral culture	The virus is cultured and isolated from a patient specimen.	Lesion exudate
Electron microscopy	Morphologically demonstrate the pox viruses.	Biopsy, scab lesion, vesicular exudate
Immunohistochemistry	Demonstrates Orthopoxvirus-specific antigens.	Biopsy
Anti-Orthopoxvirus immunoglobulin G (IgG) and immunoglobulin M (IgM) tests	Evaluate a recent or previous exposure to Orthopoxvirus.	Blood sample

9. Differential Diagnosis

DIAGNOSIS



DIAGNOSIS

- * SWABBING FLUID from LESIONS



- * PERFORMING a POLYMERASE CHAIN REACTION to look for VIRAL DNA



TREATMENT

"SELF-LIMITING" DISEASE



- * TREATMENT INVOLVES SUPPORTIVE CARE

- * ANTIVIRAL MEDS can be GIVEN to INDIVIDUALS WITH, or at risk of developing, SEVERE DISEASE

Tecovirimat, aka:
TPOXX



PREVENTION



* ISOLATION of INFECTED PEOPLE

* HAND HYGIENE MEASURES



* PERSONAL PROTECTIVE EQUIPMENT

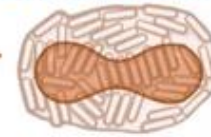
* AVOID DIRECT or INTIMATE CONTACT with INFECTED PERSONS and THINGS



MONKEYPOX



SMALLPOX



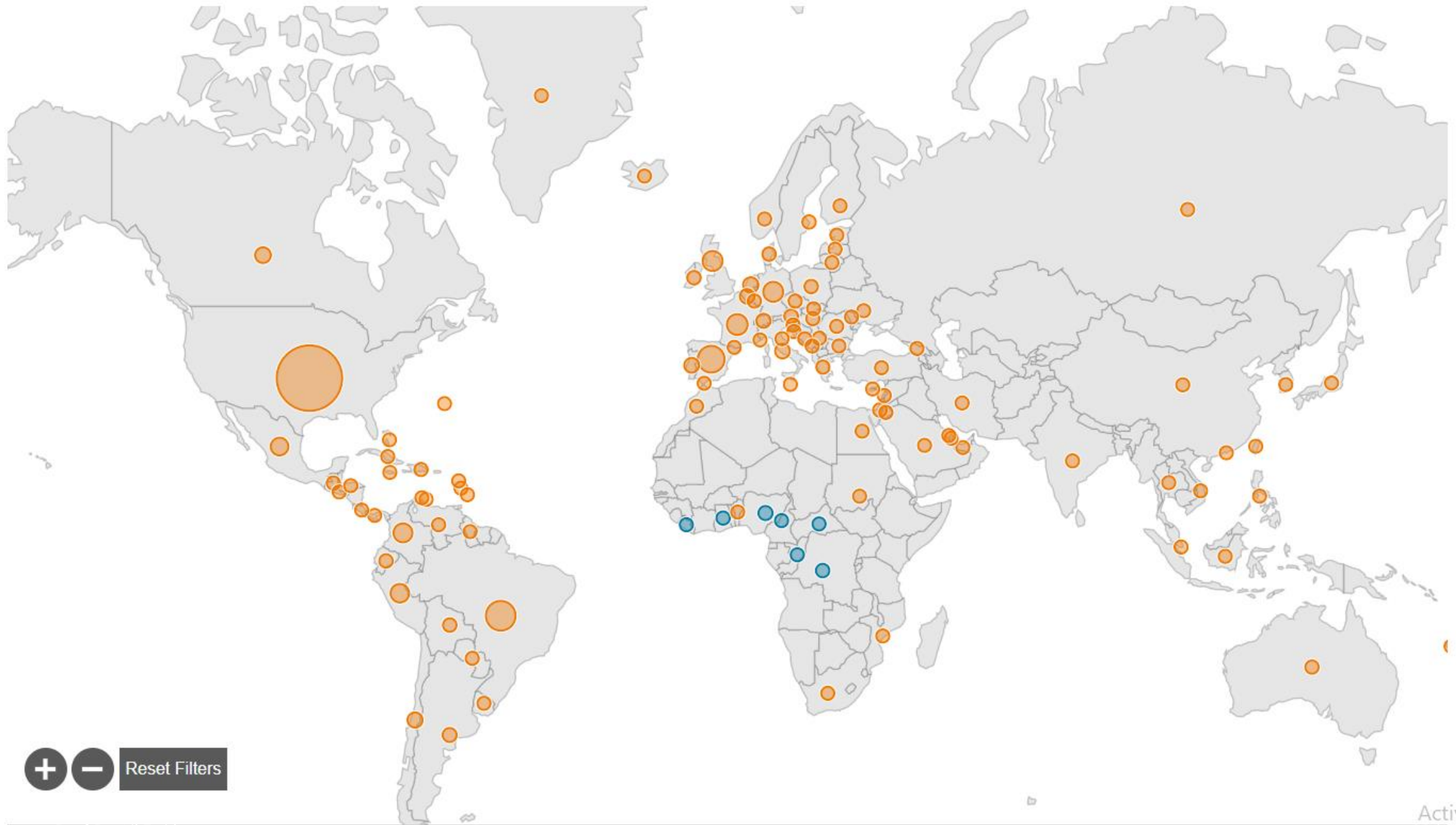
genus

ORTHOPOXVIRUS

* SMALLPOX VACCINE can be used as prophylaxis to people in high risk groups or following a high-risk exposure



85% PROTECTIVE



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11/4/2022

Hot.Dr.AfZur

