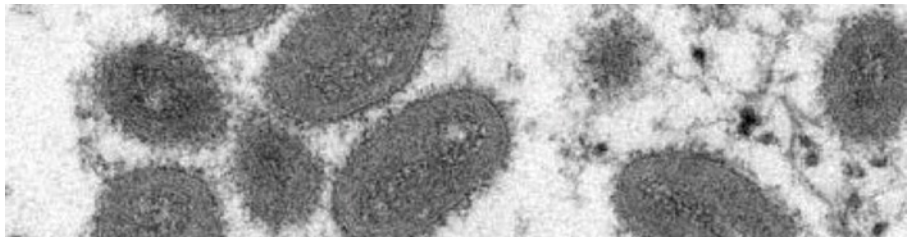
A HUMAN INFECTION CAUSED BY

Bull. Org. mond. Santé
Bull. Wld Hlth Org. } 1972, **46**, 593-597

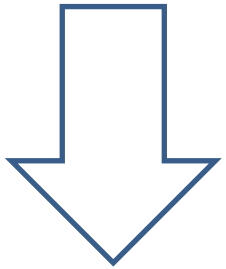
A human infection caused by monkeypox virus in Basankusu Territory, Democratic Republic of the Congo *

I. D. LADNYJ,[1] P. ZIEGLER,[2] & E. KIMA [3]

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.



On 1 September 1970



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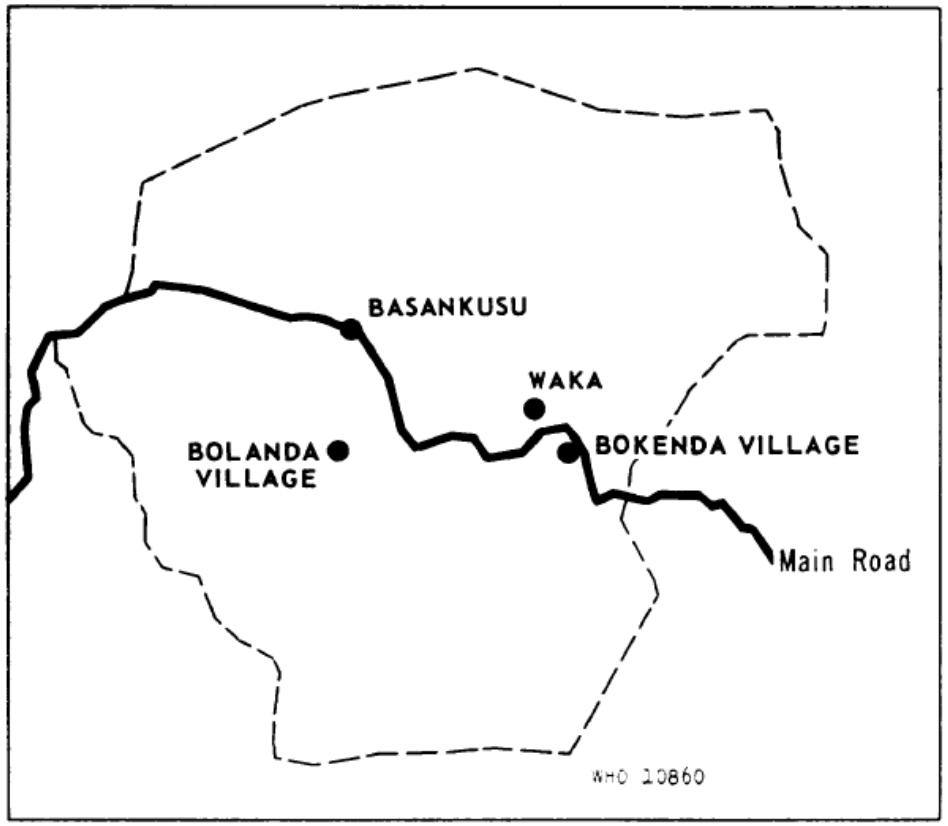
Journey to Public Health Emergency of International Concern (PHEIC)

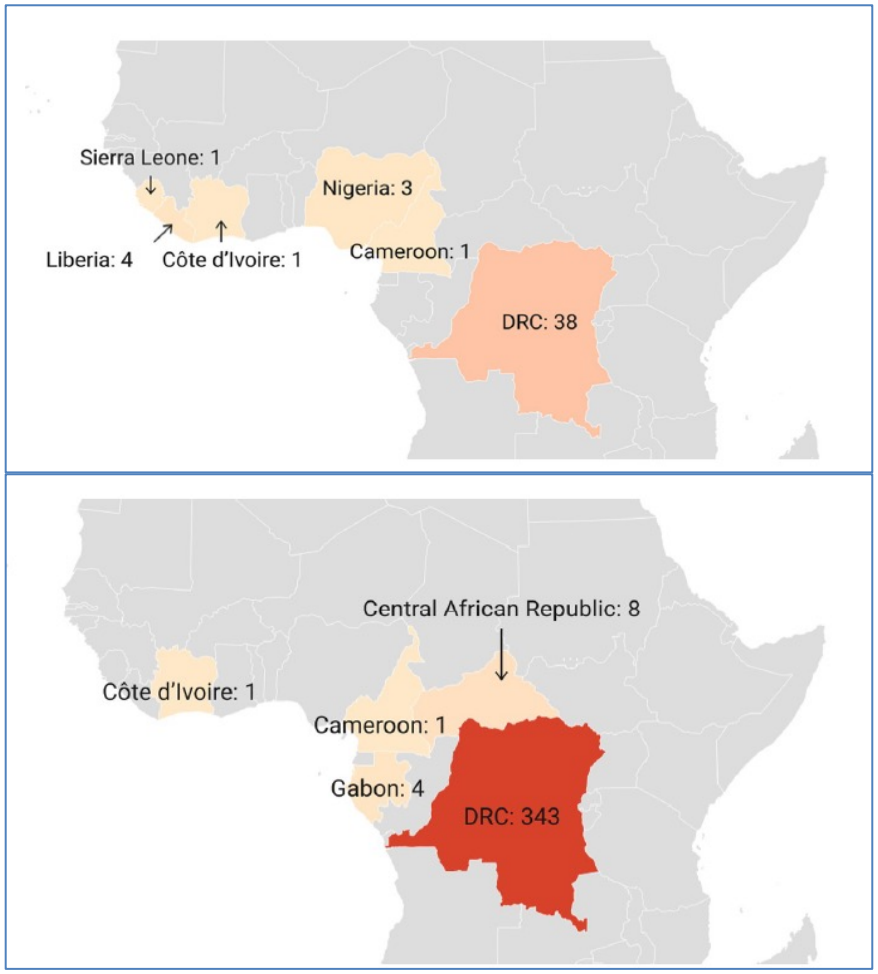
World Health Organization

HEALTH EMERGENCIES programme

Occurrence of monkeypox virus in widely scattered areas of Africa during 1970 -1979



"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".



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

World Health Organization

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Number of confirmed, probable, and/or possible monkeypox cases between 1990-2009

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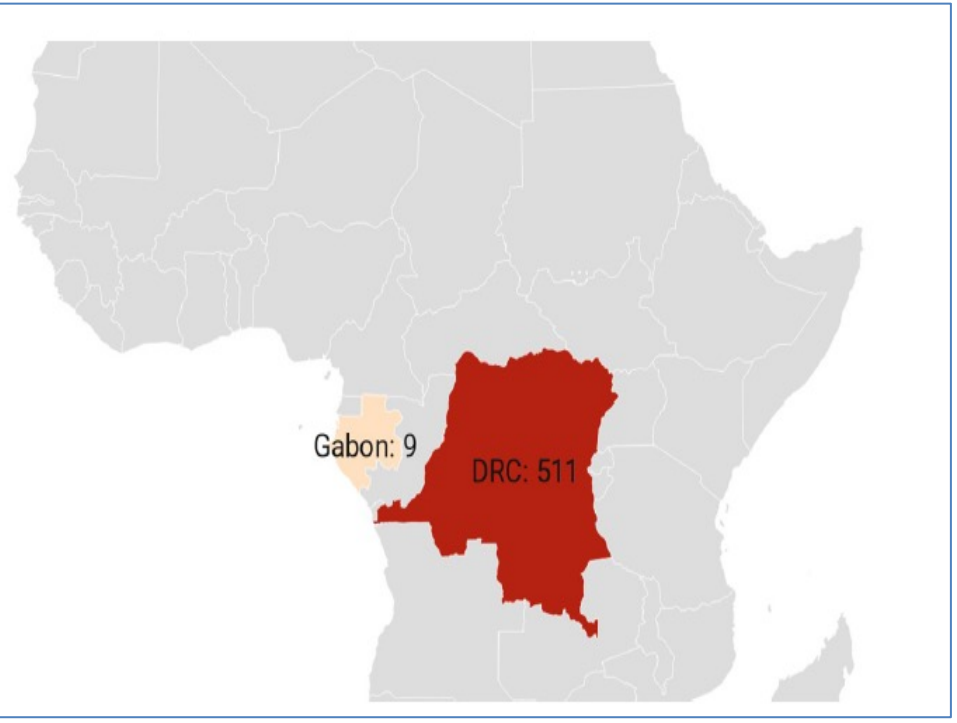
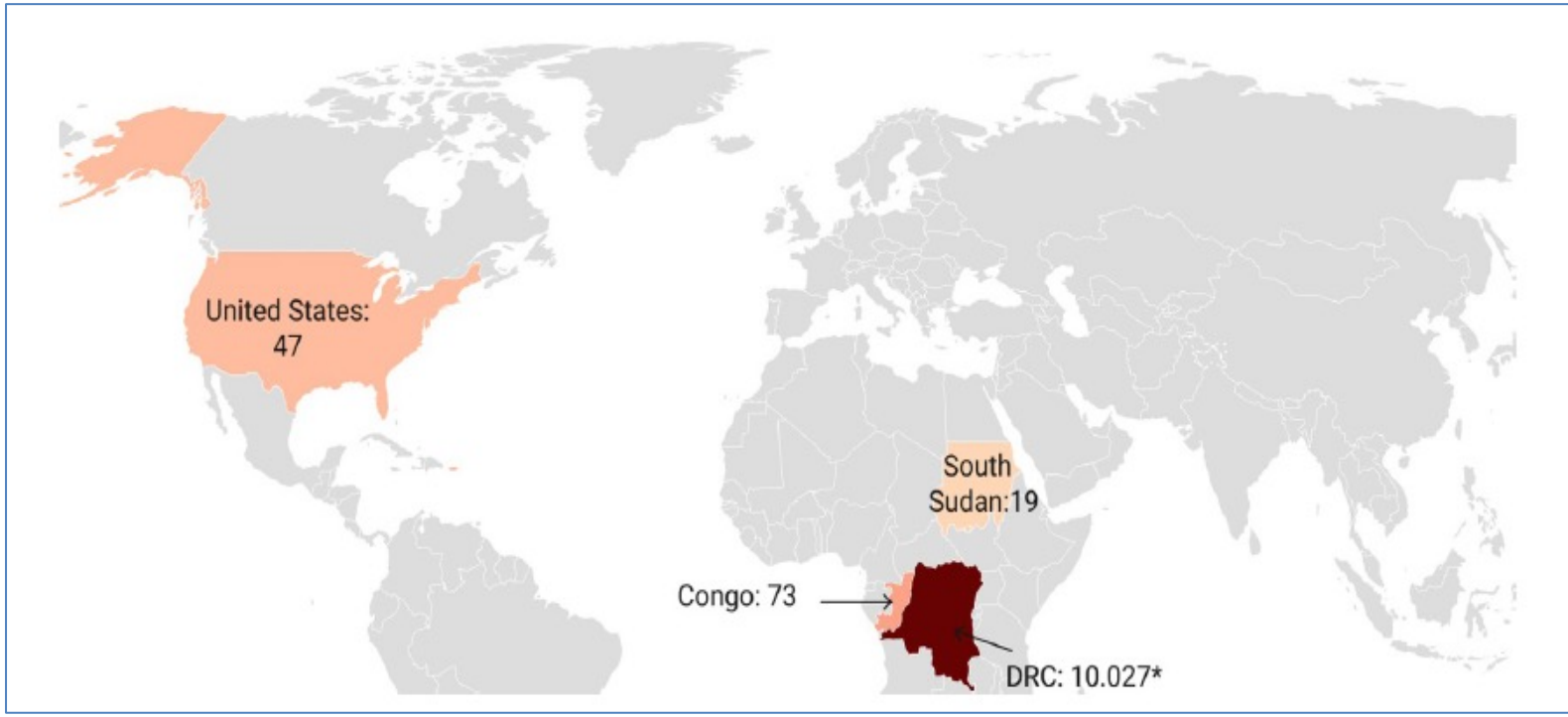


Number of confirmed, probable, and/or possible monkeypox cases between 1990-1999.



Number of confirmed, probable, and/or possible monkeypox cases between 2000-2009.

Number of confirmed, probable, and/or possible monkeypox cases between 2010–2019

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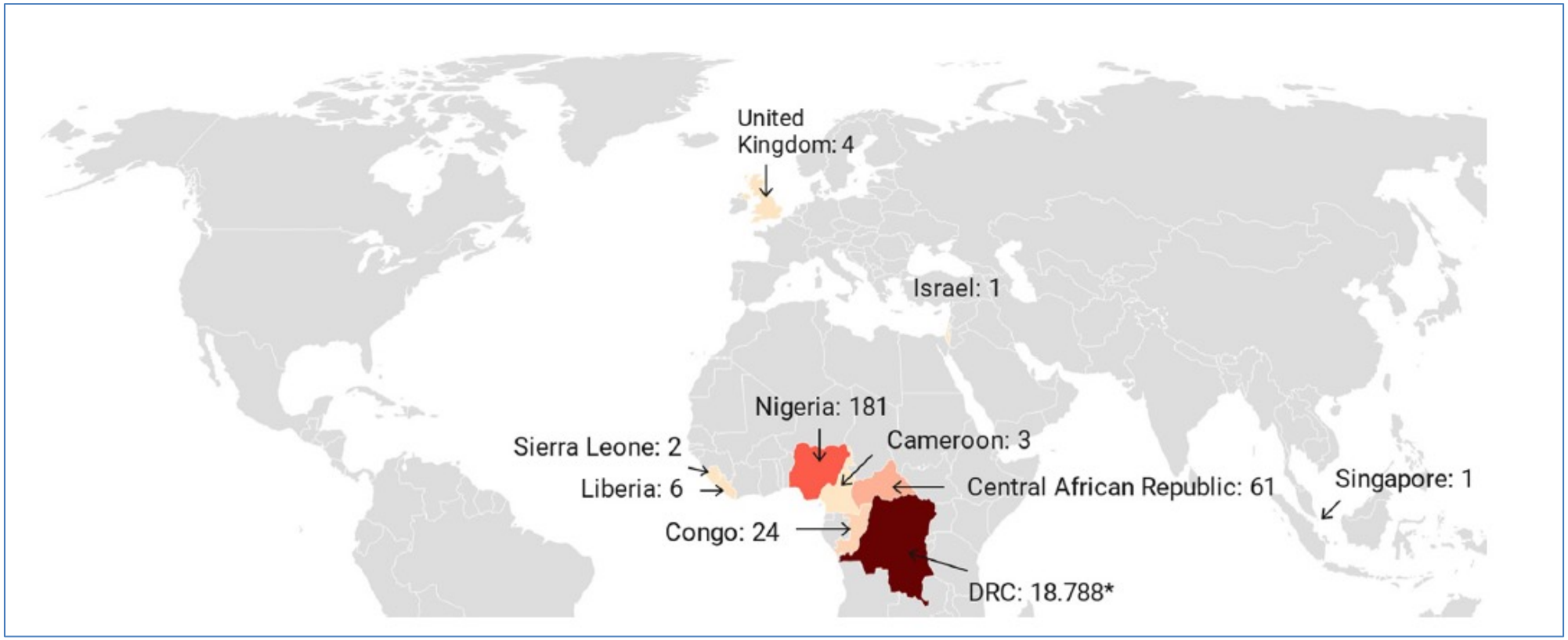

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Transmission Potential of Monkeypox Virus in Africa

World Health Organization

HEALTH EMERGENCIES programme

Transmission Potential of Monkeypox Virus in Human Populations (1980-1984) in DRC

Two pertinent questions were addressed in 1988

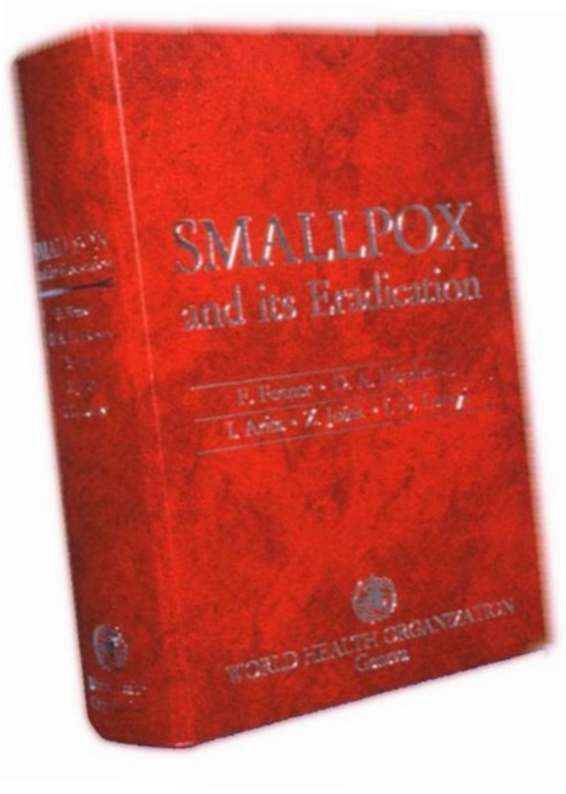
- **1) What is the epidemic potential of monkeypox in unvaccinated human population?**
- **2) Is it possible that monkeypox could persist in unvaccinated human populations through continuous-person-to-person transmission?**

Fine et al. 1988, The transmission potential of monkeypox virus in human populations. Intonational Journal of Epidemiology

Cessation of routine smallpox vaccination: emergence of monkeypox disease

In 1980:

- 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

Collaboration and motivation are key elements often overlooked to strengthen surveillance

- Technical assistance (material, and epidemiological investigations) provided by mobile surveillance teams
- Affected localities as well as village-based surveillance
- A reward of 500 Zaïres (90 US$) was offered to any person, including health staff, who reported a case of human monkeypox
  - Was it sustainable to continue paying USD 90 to find cases and what next?

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Transmission Potential of Monkeypox Virus in Africa

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Transmission scenario was like and is like now

- Secondary attack rate (risk)
- (Basic) reproduction number (number)

  - Explore relationship between secondary attack rate and basic reproduction number
  - Application: monkeypox (ongoing global outbreak/regional/country etc.)

Transmission scenario: need for detailed and good quality epidemiological data

$$\text{2º Attack rate } *** = \frac{\text{Secondary cases } **}{\text{Individuals in contact with 1º case } *}$$

* **Denominator**

Standardise contact – eg in household

Should be susceptible (thus "at risk")

** **Numerator**

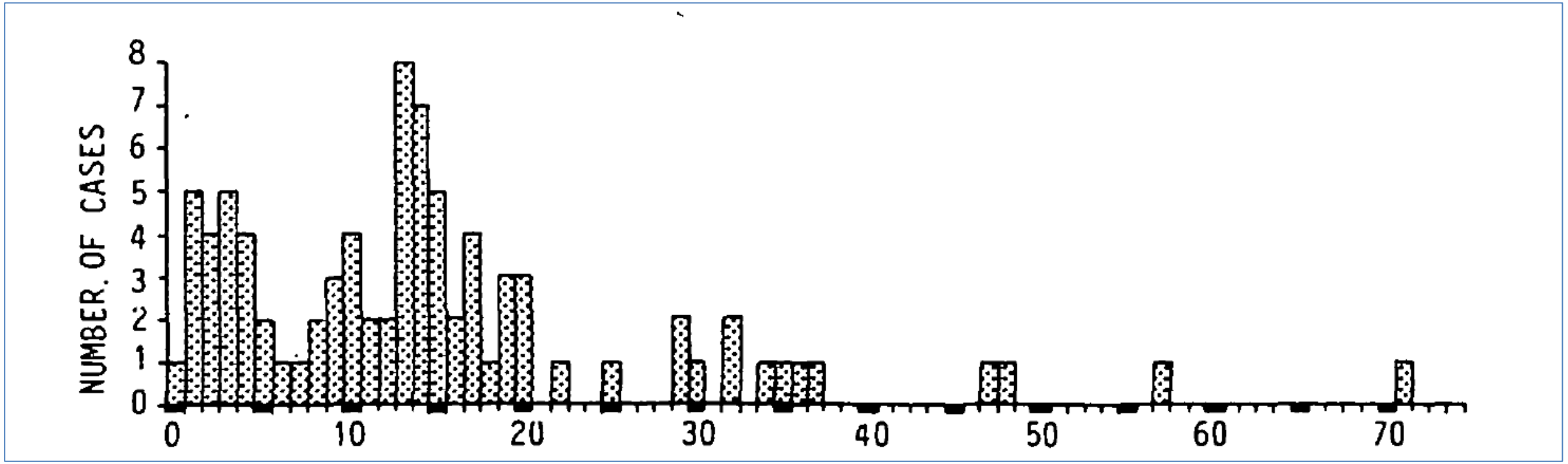
2º cases defined by serial interval

Homologous stages of 1º and 2º

Exclude co-1º and 3º

Ideally should measure infections

Distribution of rash-to-rash intervals (in days), since onset of primary case, as observed in 41 multiple-case monkeypox outbreaks in DRC 1980-1984.



RASH TO RASH INTERVAL(IN DAYS)SINCE ONSET OF PRIMARY CASE IN OUTBREAK

Fine et al. 1988, The transmission potential of monkeypox virus in human populations. Intonational Journal of Epidemiology

Relative frequency distribution of the number of contact per monkeypox case in DRC 1980-1984

Number of contacts per case	Number of cases	Relative frequency
0–4	28	0.13
5–9	81	0.39
10–14	41	0.20
15–19	25	0.12
20–24	14	0.07
25–29	13	0.06
30–34	0	0.00
35–39	4	0.02
40–44	3	0.01
TOTAL	209	1.00

- Looking for individual who may have been in contact with more than a single case!

Secondary attack rates among dose contacts of 147 primary and coprimary monkeypox cases

Vaccination status of close contacts	Same residence as primary or coprimary case			Other residence than primary or coprimary case			All contacts of primary or coprimary case		
	Number of Contacts	Cases	Attack rate	Number of Contacts	Cases	Attack rate	Number of Contacts	Cases	Attack rate
Unvaccinated	236	26	0.110	238	9	0.038	474	35	0.074
Vaccinated	598	10	0.017	501	2	0.004	1099	12	0.011
TOTAL	834	36	0.043	739	11	0.015	1573	47	0.030

Implications of Attack Rates for Virus Persistence in DRC (1988)

Assuming that cases on average contact 10.7 individuals

- 53% (ie 834/1573) of contacts would be domiciliary and at high risk (0.110)
- 47% would be extra-domiciliary and at lower risk (0.038)
- Therefore, each case should lead to:

$$10.7 \times (834/1573) \times 0.110 + 10.7 \times (739/1573) \times 0.038 = 0.815$$

subsequent cases

"On average, each case would lead to less than one subsequent case, and thus that the virus could not persist in human populations"

Basic case reproduction rate: calculated with confidence interval (upper limit estimated to 1.0: possibility of persistence in human populations)

Expected secondary attack rates in urban areas

- Great concern that the virus might be introduced into crowded urban cities in Western and Central Africa
  - Rapid spread of the infection
- Need to intensified the surveillance and detection

Increase in human monkeypox incidence 30 years after smallpox vaccination campaigns ceased in DRC

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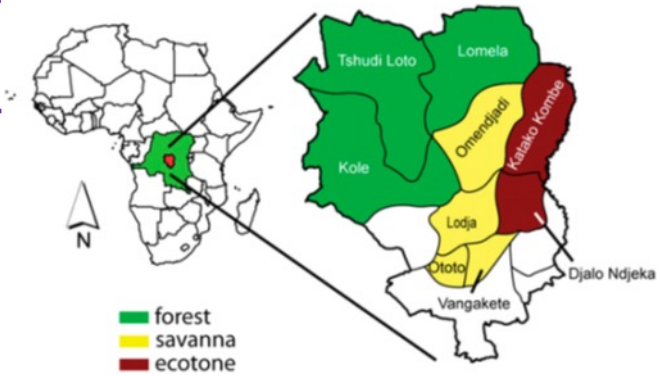
- Monkeypox is a viral zoonotic disease
- Endemic in 9+ African countr
- *Orthopoxvirus* genus
- Animal Reservoir unknown
- Two clades
- Cameroon has both



Rimoin et al , 2010

Monkeypox virus transmission cycle in Central Africa

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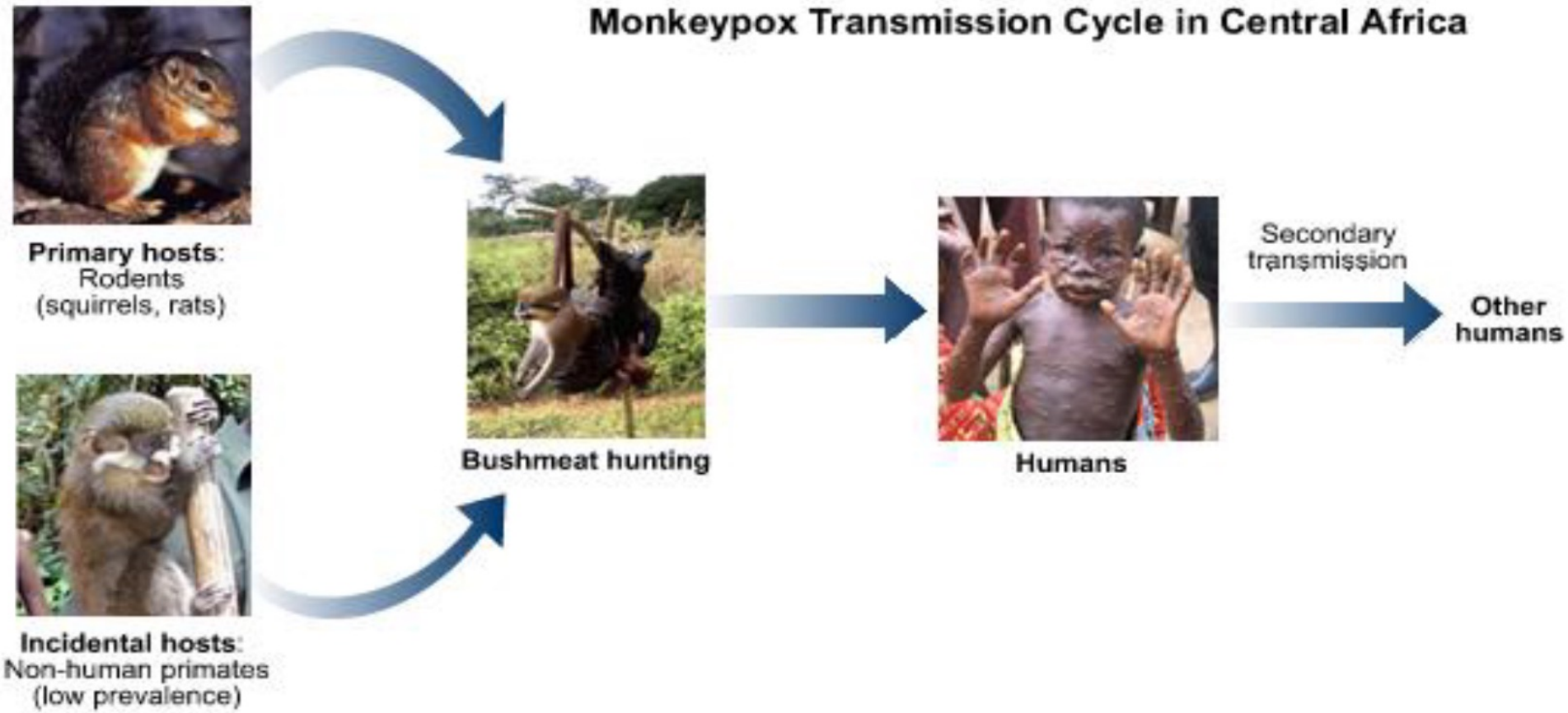
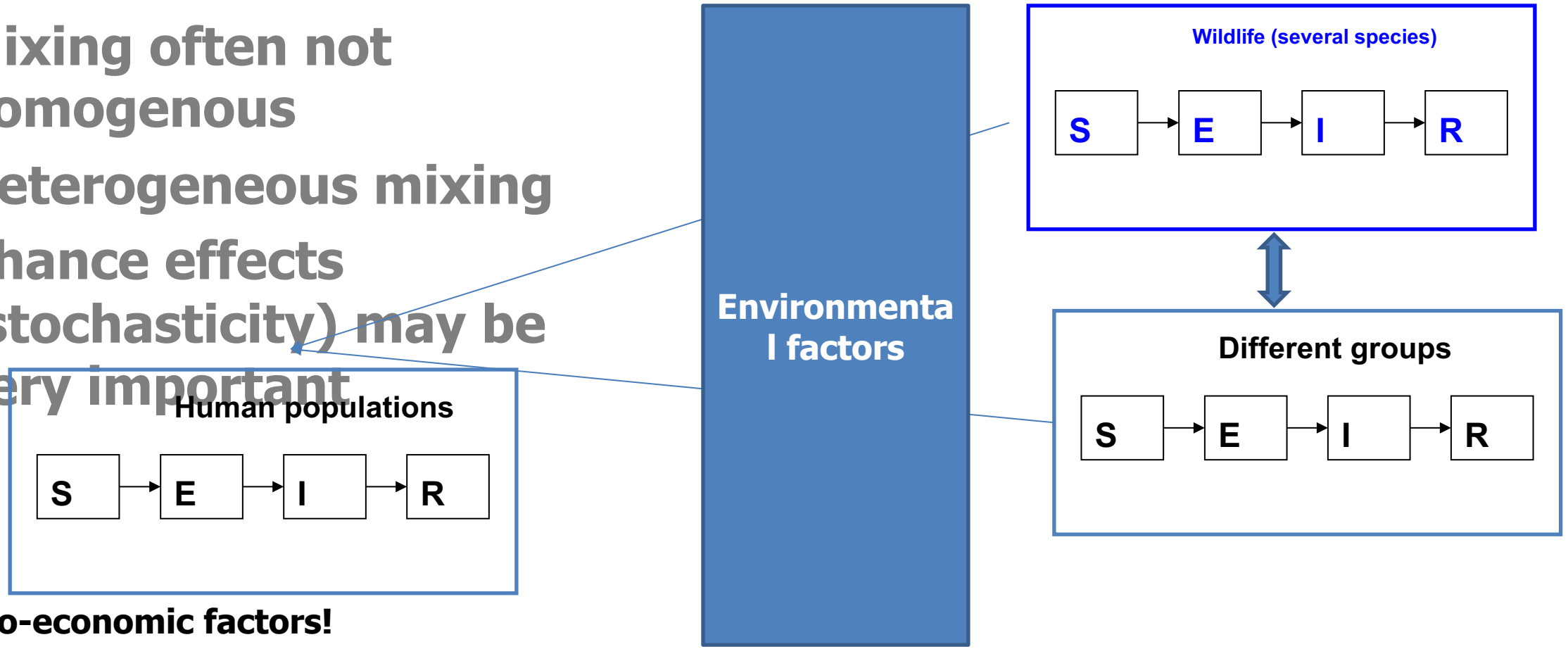


Fuller et al. 2011

Transmission scenario

- Mixing often not homogenous
- Heterogeneous mixing
- Chance effects (stochasticity) may be very important



Socio-economic factors!

Surveillance for monkeypox, transmissibility in wildlife and human population

Key attributes:

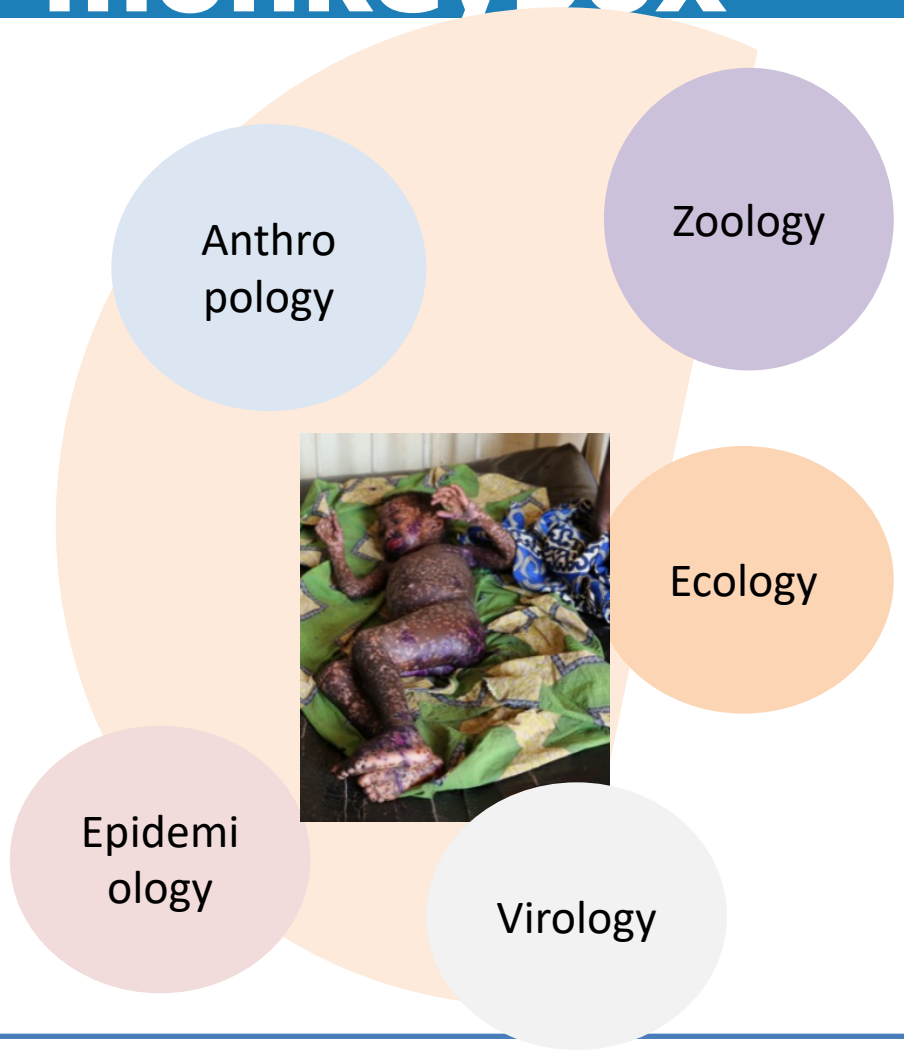
- Accuracy/completeness
- Sensitivity
- Specificity
- Timeliness
- Cost
- Simplicity

Human population

Animal population

Environment

AFRIPOX : A One Health approach of monkeypox

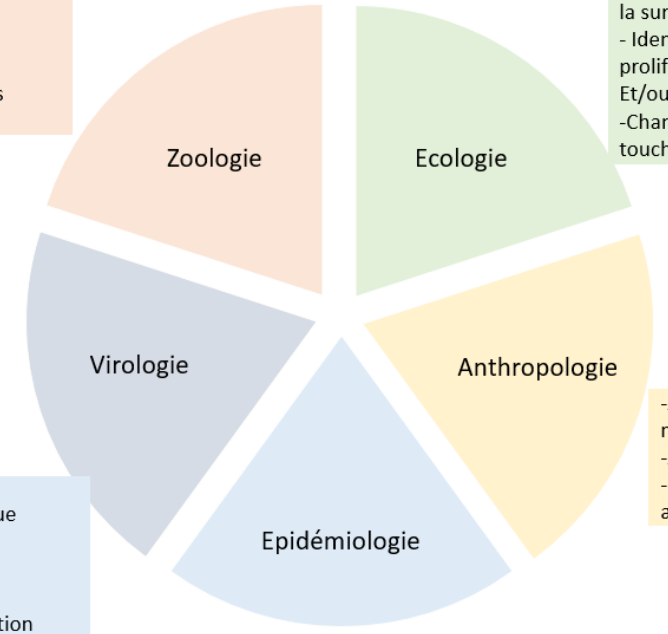


Central African Republic (CAR)

-Identification réservoir animal et hôtes intermédiaires
- Facteurs favorisant la prolifération du réservoir et l'augmentation des contacts réservoir/humains

-Caractérisation des environnements favorables à la survenue d'épidémie
- Identification des écotopes favorables à la prolifération du réservoir animal
Et/ou aux interactions humain/animal
-Changement écologiques récents dans les zones touchées

-Développement d'un nouveau test sérologique plus spécifique
-Développement test diagnostic moléculaire de terrain
-Séquençage, phylogénie, phylogéographie



-Anthropologie de la santé et de la maladie
-Approche Ethnohistorique
- Ethnoécologie-pratiques actuelles avec faune sauvage

-Description des formes cliniques
-Facteurs de risque de transmission zoonotique interhumaine
-Facteurs de risque environnementaux
-Évaluation des tests diagnostics
-Mesure de la réponse sérologique post infection
-Potentiel épidémique et immunité des populations

World Health Organization

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Greater concern that the virus might be circulating (undetected)

- Multisectorial coordination mechanism
- Surveillance and diagnostic
- Vaccination (pre-exposure and prophylactic)
- Treatment (clinical and psychological support)
- Infections prevention and control (IPC)
- Risk communication & communication engagement (active)
- Research

THANK YOU
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