AFRIPOX
A One Health approach of monkeypox in the Central African Republic

Emmanuel Nakouné & Arnaud Fontanet

2-3 June 2022 – WHO monkeypox research webinar
One health – monkeypox - CAR

**VIROLOGY**
- Molecular field diagnostic test
- Sequencing & phylogeny
- Serological test

**ZOOLOGY**
- Animal reservoir and intermediate hosts identification – proliferation - contacts

**ECOLOGY**
- Environnement, ecotopes, ecological changes

**ANTHROPOLOGY**
- Illness, changing ecologies, wildlife

**EPIDEMIOLOGY**
- Surveillance, outbreak investigation, modeling, transmission, natural history

**CLINICAL RESEARCH** with University of Oxford: clinical trial of tecovirimat
EPIDEMIOLoGY

40 outbreaks, size range: 1 to 13 (1 to 25)
99 confirmed cases, (160 with suspected cases)
Case-fatality rate: 12/160(7.5%)

(Besombes et al, in preparation)
VIROLOGY – diagnostic tools

Molecular field diagnostics

- Monoplex (RT-LAMP) and multiplex (RT-LAMP QUASR) rapid tests
  Integrated test cartridges (Withings) (MPX lineage, VZV)

- Detection by isothermal amplification / RPA strip technology

Serological diagnostic tests

- Multiplex test based on a library of more than 7891 viral peptides representative of the proteome of human pathogenic OPXV (MPXV, VACV, CPXV, VARV) (PhiP-Seq)

- Multiplex assay based on a combination of a selection of 10 MPXV proteins and peptides (MMIA)
VIROLOGY - sequencing

- Use of capture probes for long DNA fragments

- Microfluidic technology and droplet generation for targeted enrichment of droplets containing viral genome fragments

- Direct Illumina sequencing, or direct and real-time MinION sequencing on samples

(Berthet et al, Scientific Reports, 2021)
AFRIPOX: ZOOLOGY

**ZOOLOGY – Ecological niche**

Curaudeau *et al.*, in prep

Ecological Niche Modelling with MaxEnt in R

---

**African squirrels as a potential reservoir of Monkeypox virus**

1. **MPXV isolated from two African squirrels**
   - *Funisciurus anerythrus* (Khodakevich *et al.*, 1986)
   - *Funisciurus bouyoni* (Mariën *et al.*, in review)

2. **MPXV DNA in African squirrel museum specimens** (Tiee *et al.*, 2018)
   - Five species of *Funisciurus* including two new species

3. **Anti-OPXV antibodies in African squirrels** (Khodakevich *et al.*, 1988)
   - *Funisciurus*
   - *Heliosciurus*
   - African squirrels are good candidates for the reservoir of Monkeypox virus
   - Focus on African squirrels
Animal samples: 250

2019 Toma outbreak
2021 Moloukou outbreak
2021 Grima outbreak

Rodents, duikers, squirrels, bats, pangolins

PCR
Serological assay
ECOLOGY

Environmental atlas
Climate profile
Human activities

DEFORESTATION
- **Anthropological investigation** of monkeypox illness, diagnosis & treatment pathways, care: formal health care workers, traditional healers, former patients

- **Participatory investigation of « local epidemiologies »** (local understandings of origins, emergence, transmission)

- **Ethnohistorical** study of local ecological (forest, wildlife) & social changes implied in monkeypox emergence in the CAR since 1970

- **Ethnoecology**: local conceptions and observations of wildlife; current practices with wildlife
Collaborators

Festus Mbrenge
Christian Malaka
Ella Gonofio
Xavier Konamna
Benjamin Selekon
Joella Namsenei Dankpea
Franck Gislain Houndjahoue
Daniel Sylver Ouaïmon
Emmanuel Nakouné Yandoko

Camille Besombes
Romulus Breban
Laura Schaeffer
Arnaud Fontanet

Nicolas Berthet (IP Paris & IP Shanghai)
Lingjing Mao (IP Shanghai)
Jessica Vanhomwegen
Valérie Caro
Christophe Batejat
Jean-Claude Manuguerra

Cassandra Von Platen

Antoine Gessain
Romain Duda
Tamara Giles-Vernick

Funding

ANR
AGENCE NATIONALE DE LA RECHERCHE

SCOR
FONDATION POUR LA SCIENCE

INSTITUT PASTEUR

Manon Curaudeau
Alexandre Hassanin

Jordi Landier
Pascal Handschumacher
Jean Gaudart