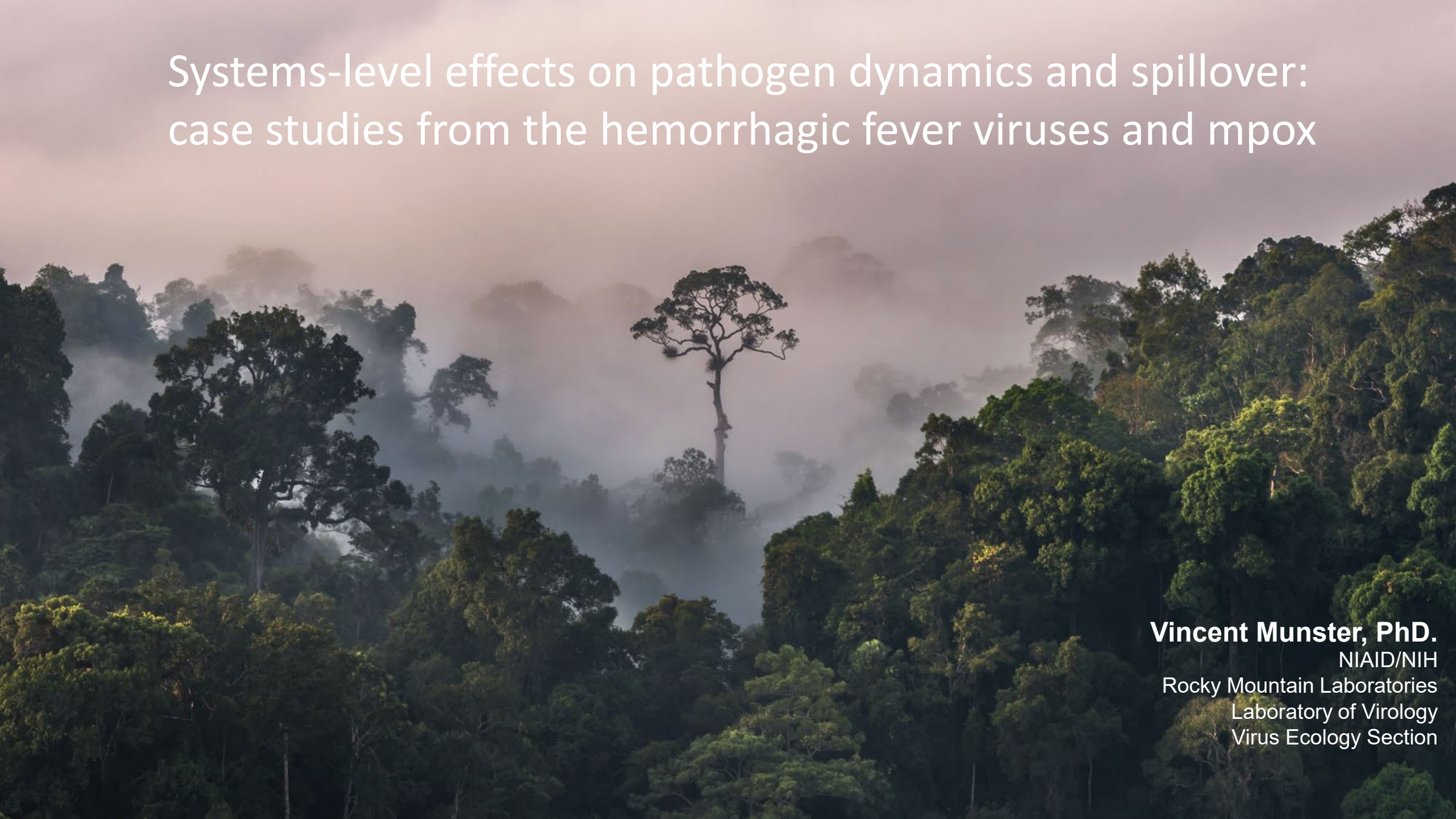


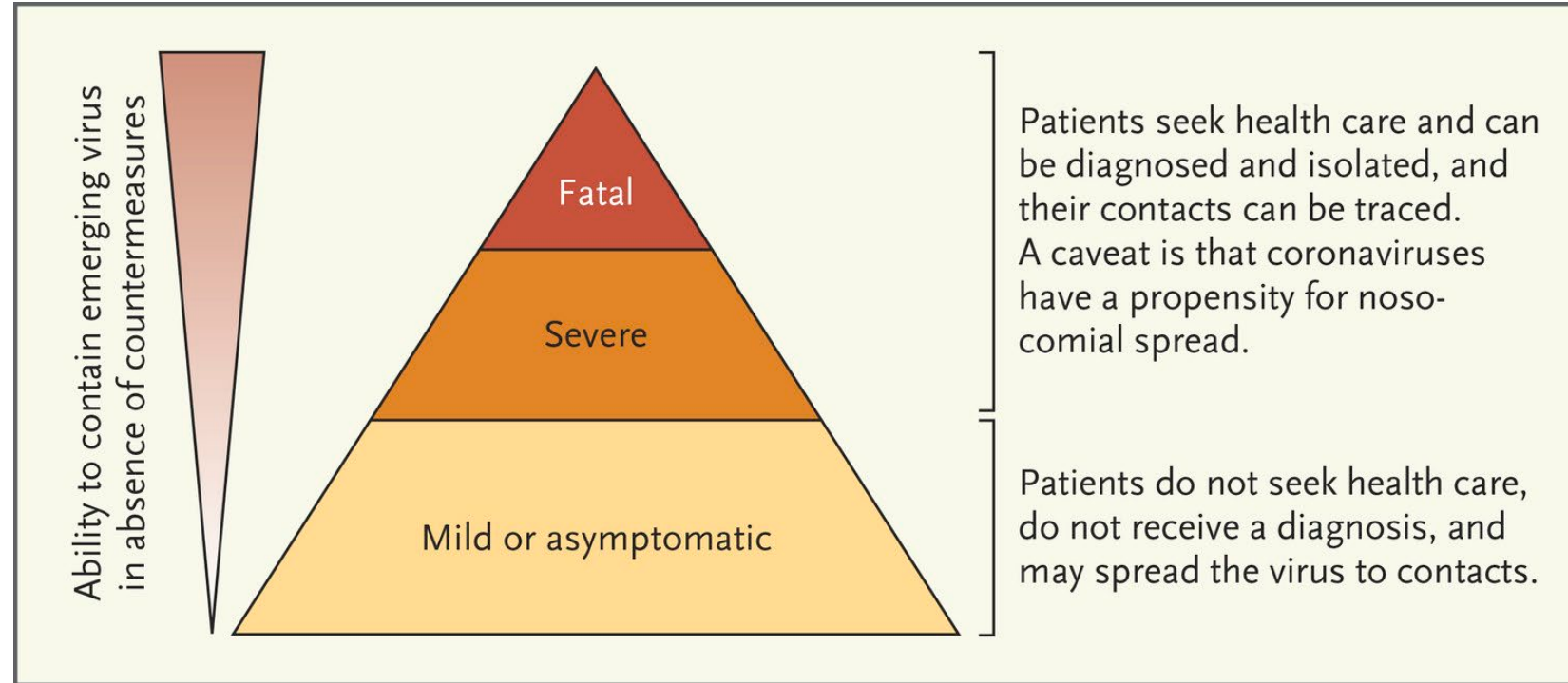
Systems-level effects on pathogen dynamics and spillover: case studies from the hemorrhagic fever viruses and mpox

A photograph of a dense tropical forest with thick mist or low clouds filling the background. A single, tall, slender tree with a wide canopy stands out prominently in the center of the frame. The foreground is filled with the lush green foliage of the forest canopy.

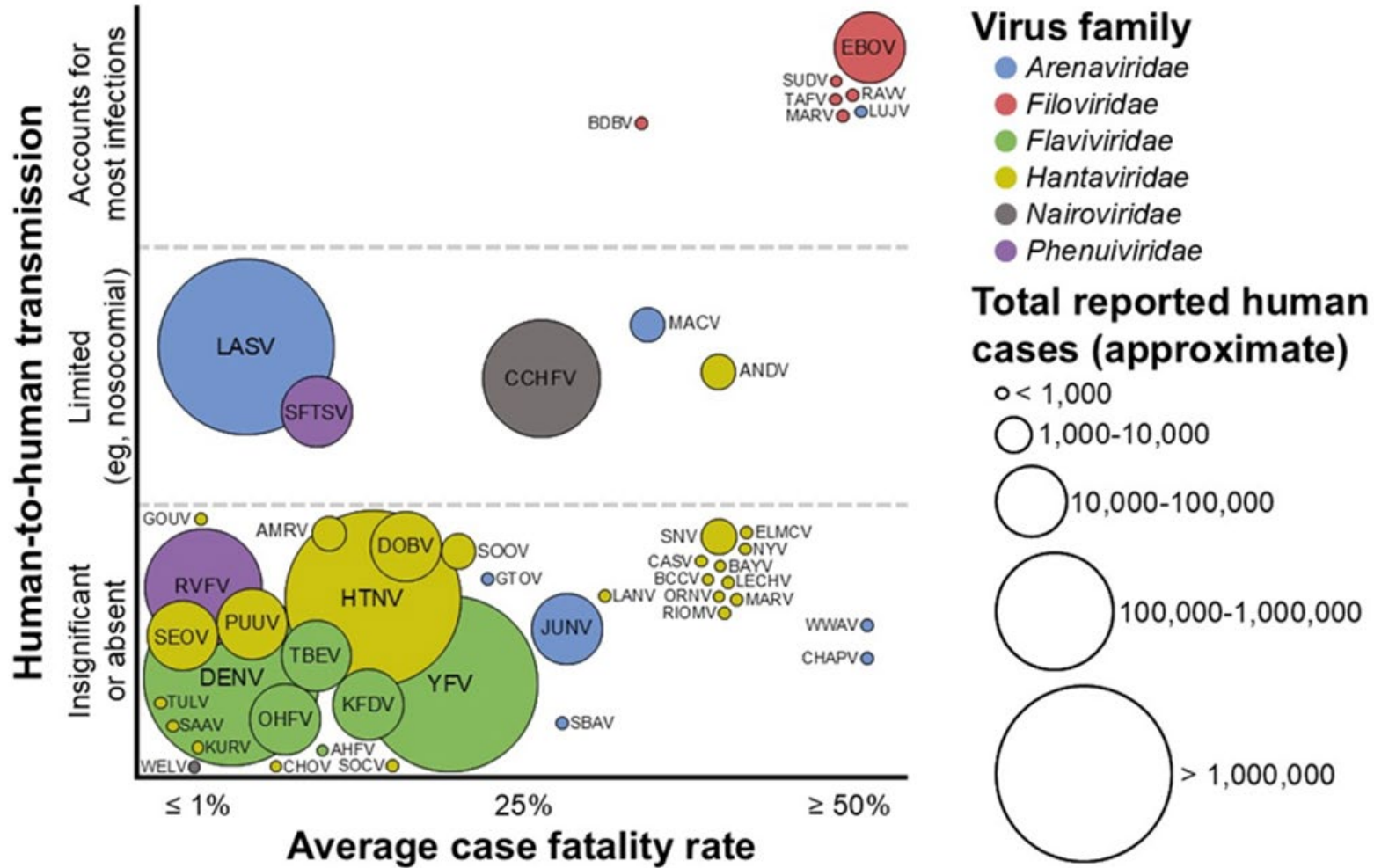
Vincent Munster, PhD.
NIAID/NIH
Rocky Mountain Laboratories
Laboratory of Virology
Virus Ecology Section

No conflicts of interest

Patient zero paradigm – preparedness post COVID



Why is Ebola virus special?



Origins of Ebola disease Outbreaks

Single Spillover



Example:
2013-2016 West African Epidemic

Multiple Spillover



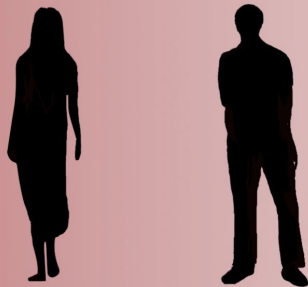
Example:
2003 Republic of the Congo

Epizootic Spillover

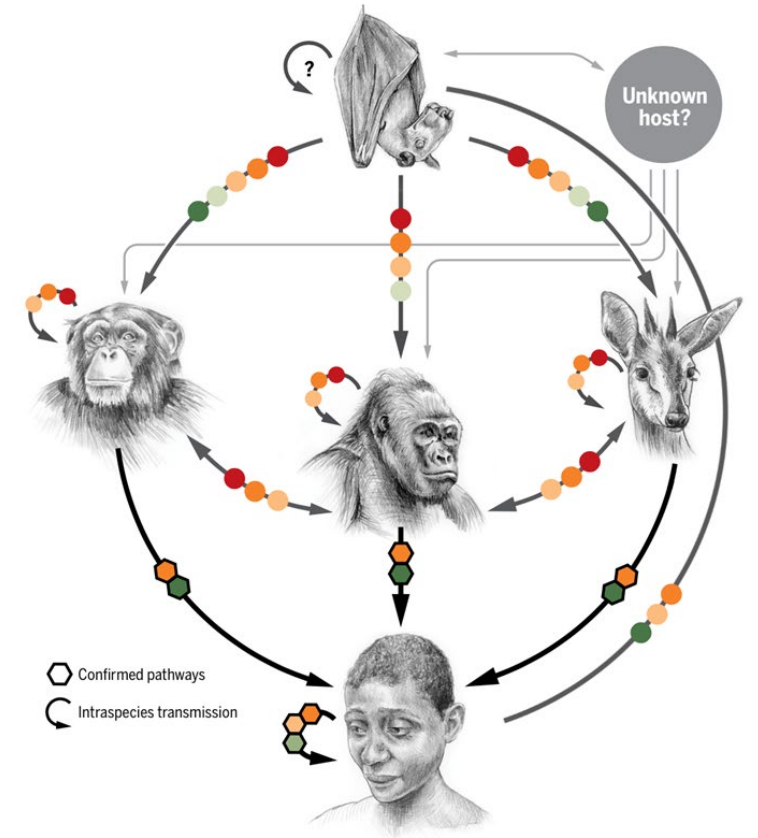


Example:
2001-2002 Gabon and Republic of the Congo

Human-to-human



Example:
2021 Guinea



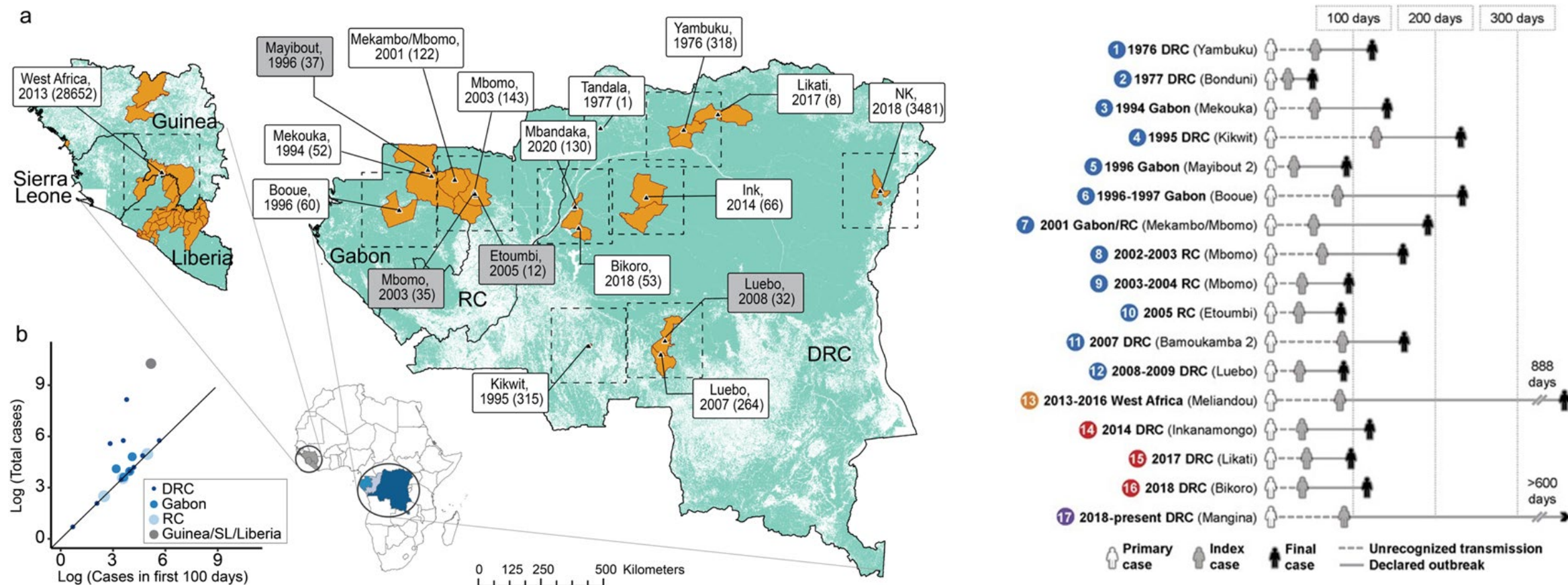
Modes of transmission

- Contact with feces of infected animal
- Contact with dead infected body
- Contact with living infected entity
- Meat of infected animal consumed
- Contact with infected medical equipment
- Ingest fruit partially eaten by infected animal

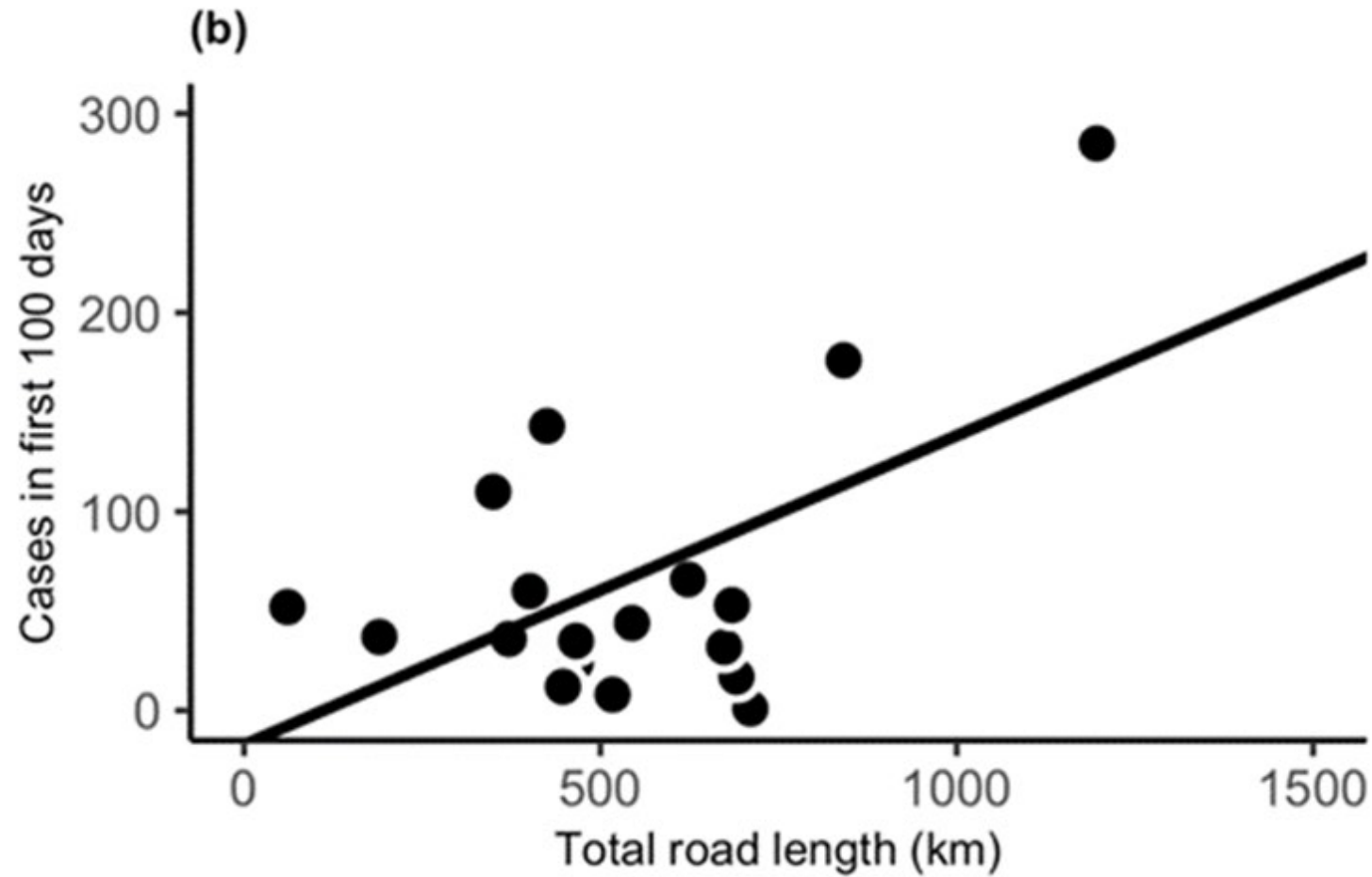
V. ALTOUNIAN/SCIENCE

Why is Ebola virus special

- the need for rapid identification of spillover -



Ebolavirus: changing spatial connectivity in Africa



2011



2012



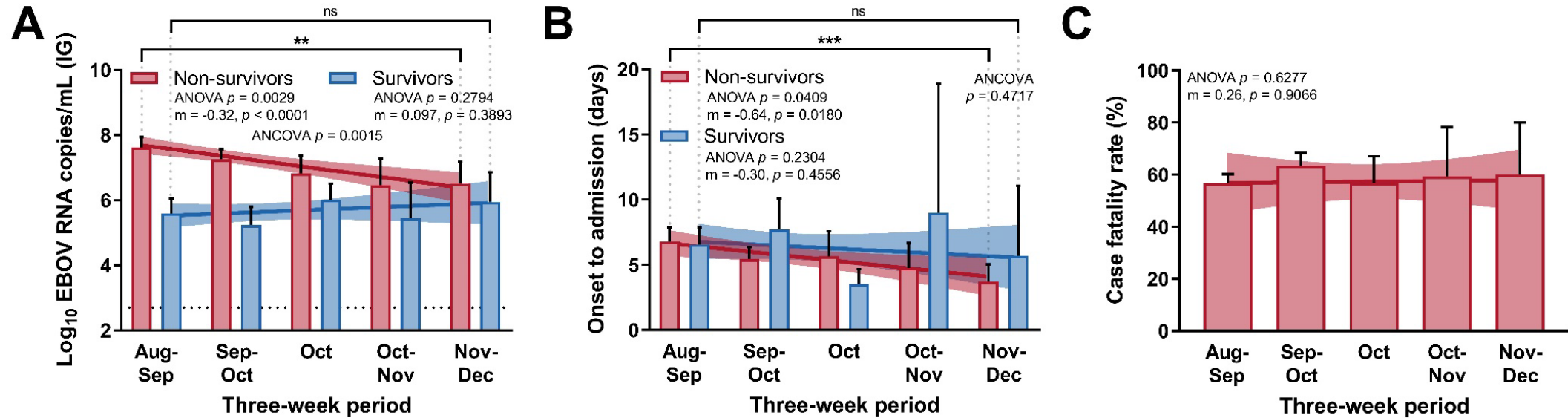
2014



2015

Ebolavirus: access to ETU's and speed of diagnostics

-Lower viral loads not associated with a decrease in CFR -

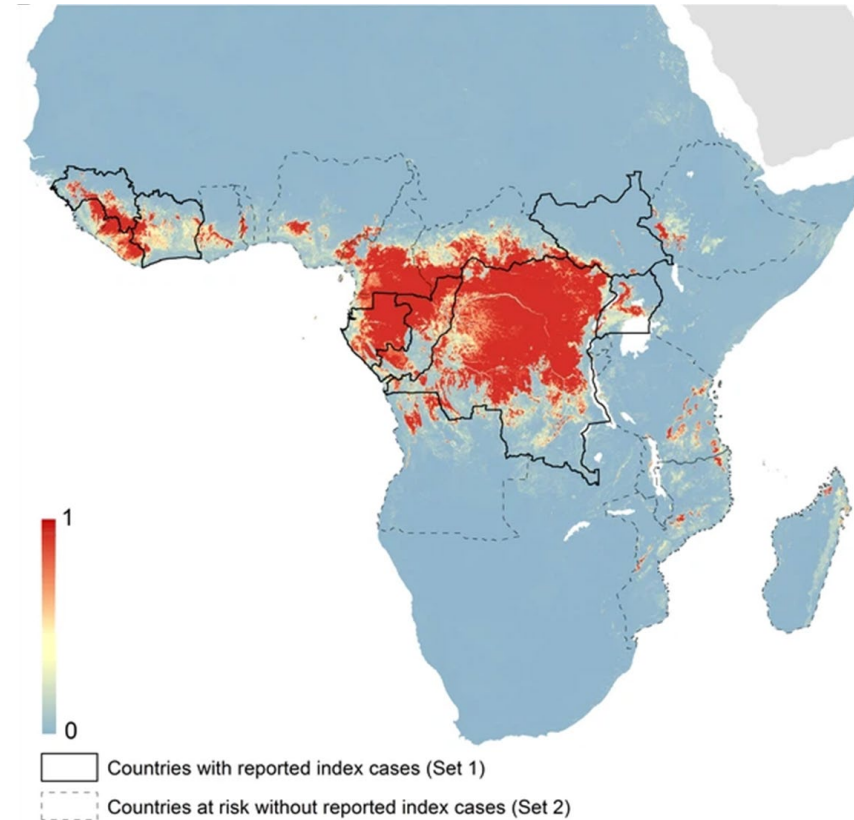
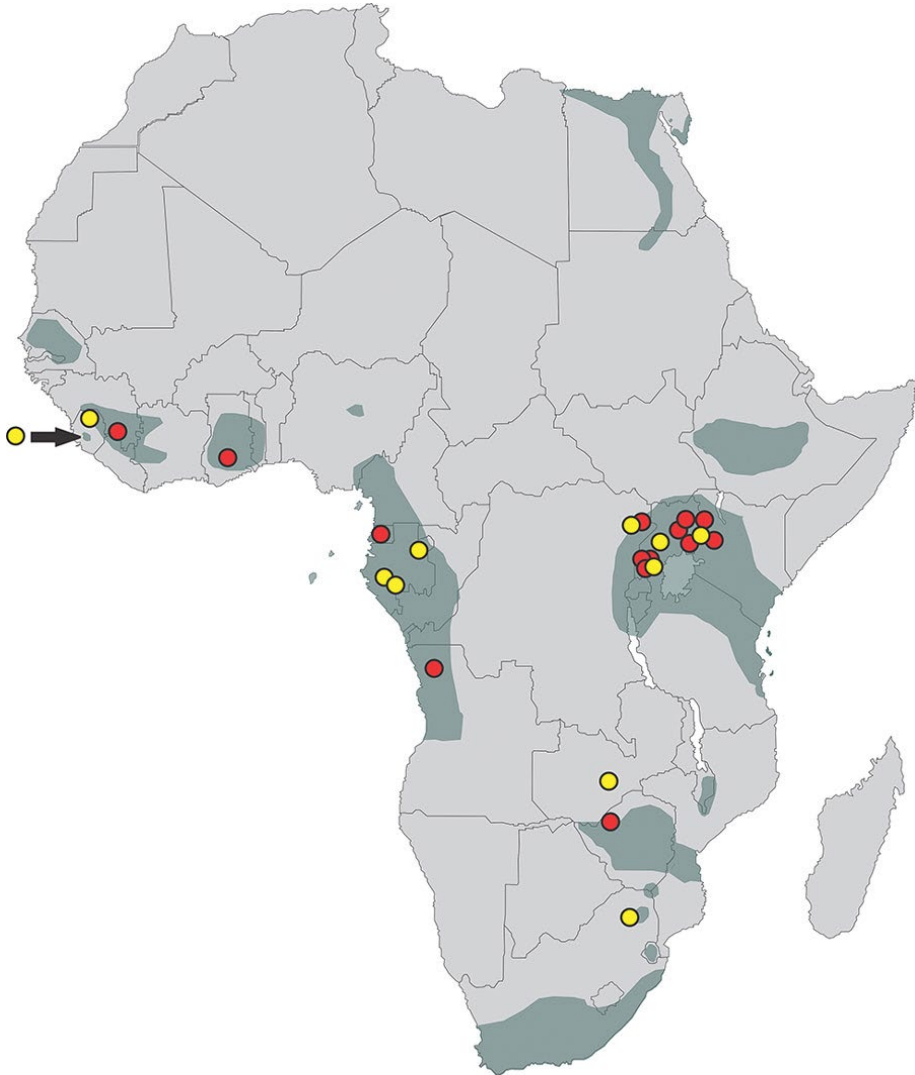


- Viral load decreased over time in the outbreak
- Time to admission significantly lower at the end of the outbreak
- No change in the CFR over the course of the outbreak

- Filovirus spillover predictability - Marburg - Rousettus host mapping shows clear spillover risk

Locations of:

- known Marburg virus disease spillover events into humans (red dots)
- Egyptian rousette bats (*R. aegyptiacus*) that previously tested positive for Marburg or Ravn viruses (yellow dots).

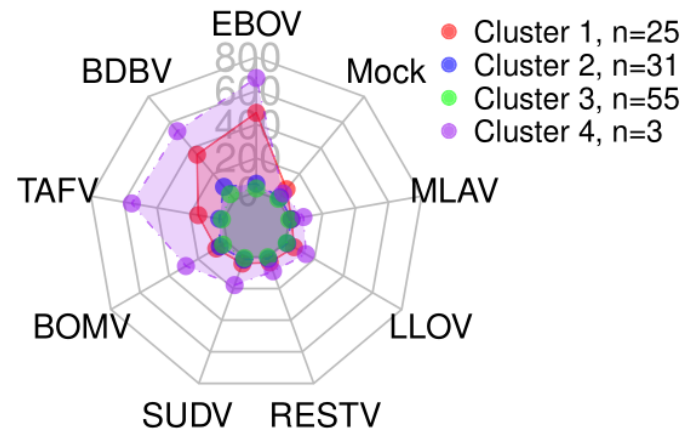




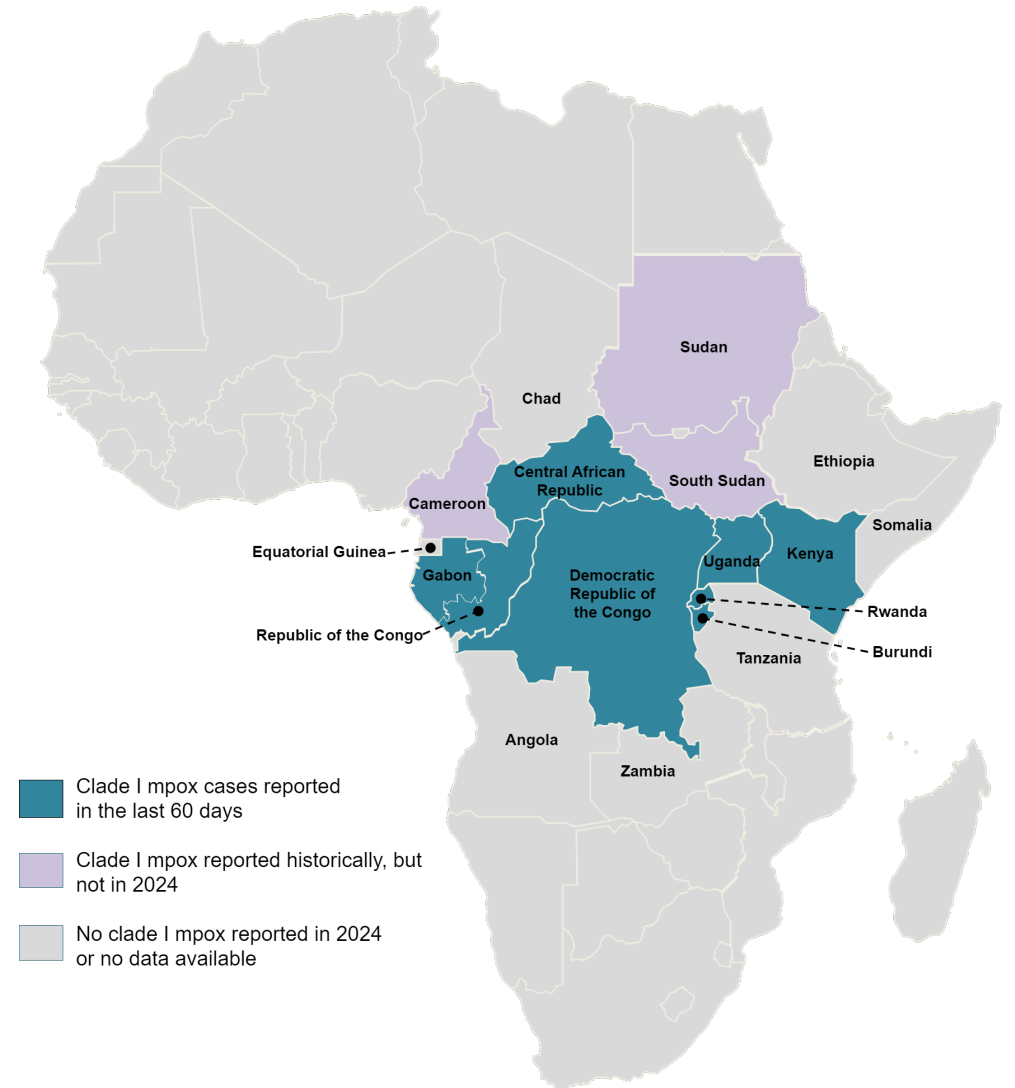
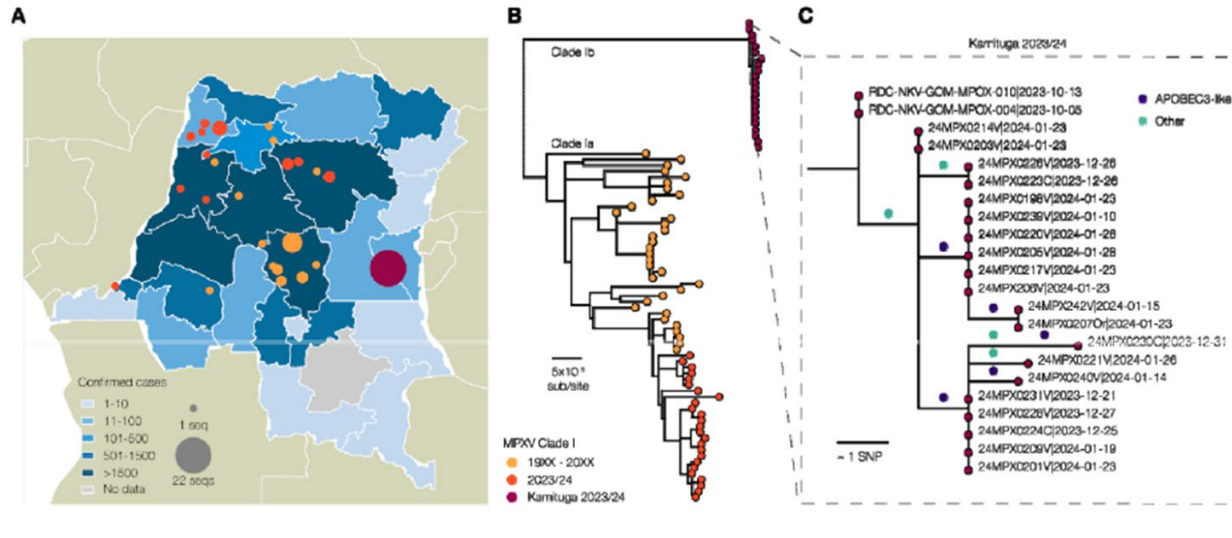
Human-animal interface, Republic of the Congo

Local indigenous population (Baaka)

	F	F+	% pos	M	M+	% pos
0-10	8	1	12.5	11	1	9.1
11-20	7	1	14.3	10	2	20.0
21-30	11	3	27.3	13	5	38.5
31-40	3		0.0	8	3	37.5
41-50	6		0.0	8	1	12.5
51-60	8	5	62.5	5	4	80.0
61-70	4	4	100.0	2	2	100.0

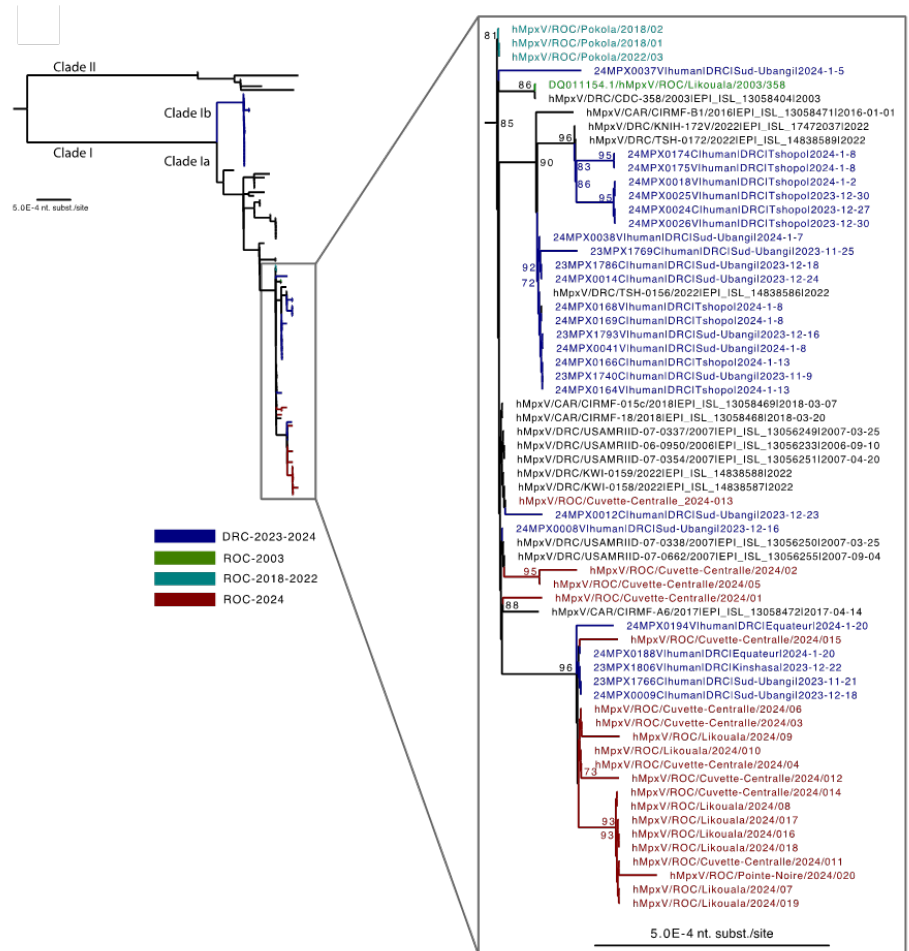
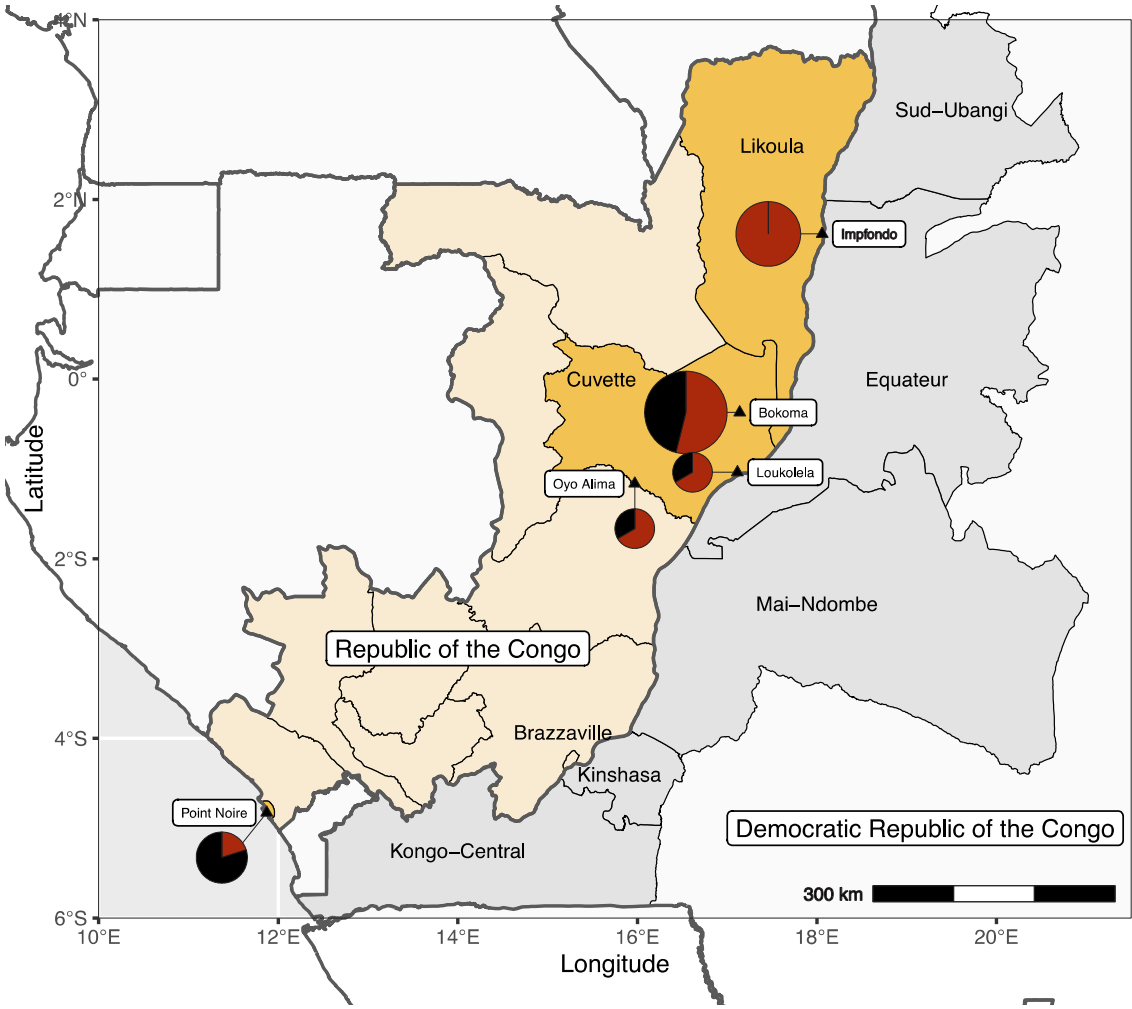


Mpox Clade 1 current situation Africa





Mpox Nanopore sequencing, outbreak response April 2024



Knowledge gaps and perspective

- The diversity of filoviruses in bats / reservoir hosts is still poorly understood
- The geographical “at risk” area has increased dramatically over the last decade
- A better understanding of the drivers of Filovirus spillover are needed
- Rapid diagnosis can limit outbreak size
- Limited decentralized diagnostics for priority pathogens available
- Limited ability to respond to truly novel pathogens in most of the world

Acknowledgements

Virus Ecology Section

Brown Bulloch
Gus Courchesne
Neeltje van Doremalen
Shane Gallogly
Kailin Hawes
Franziska Kaiser
Kwe Claude Yinda
Anthony McBain
Reshma K. Mukesh
Missiani Ochwoto
Jonathan E. Schulz
Sarah van Tol
Arthur Wickenhagen

Former Lab Members

Danielle Adney
Vicky Avanzato
Trenton Bushmaker
Irene Owusu Donkor
Dania Figueroa
Bob Fischer
Benjamin Green
Myndi Holbrook
Seth Judson
Michael Letko
Jun Li
Jeremiah Matson
Rebekah McMinn
Kerri Miazgowicz
Megan Miller
Shauna Milne-Price
Julia Port
Jyothi Purushotham
Joe Prescott
Jade Riopelle
Taylor Saturday
Stephanie Seifert
John Thompson
Zack Weishampel

RML ACUC

RML support staff

NIAID DIR program



Laboratory of Virology

Trenton Bushmaker
Amanda Griffith
Tessa Lutterman
Ekaterina Altnova
Deepashri Rao
Matthew Lewis
Shanna Leventhal
Meaghan Flagg
Thomas Tipih
Kerry Goldin
Brandi Williamson
Atsu Okumura
Kimberly Meade-White
Jenna Monaco
Michael Jones
Kyle Rosenke
Dan Chertow
Heinz Feldmann
Andrea Marzi
Emmie de Wit

RMVB

Greg Saturday
Carl Shaia
Patrick Hanley
Jamie Lovaglio
Brian Smith
Chad Clancy
Kathy Cordova
Jesse Prado-Smith
Tina Thomas
Caretakers

TTIPO

Terrence Joyce
Wade Green
Maryann Puglielli

FDA

Megan Miller
Kristin Butler

RTB

Craig Martens
Kent Barbian
Sarah Anzick
Paul Beare
Beth Fischer
Austin Athman
Ryan Kissinger
Anita Mora
Lara Meyers
Aaron Carmody
Justin Lack
Skyler Kuhn
Paul Schaughency
Kimmo Virtaneva

NAMRU 3

Terrel Sanders
USDA
Lisa Hensley

CDC

Victory Kerton
Todd Davis
Sue Tong
Natalie Thornburg
Christina Hudson
Davis Wentworth

USAID

Chief Willy
Andrea Long-Wagar

EvergreenHealth

Francis Riedo

Caltech

Pamela Bjorkman

Cornell University

Raina Plowright
Hector Aguilar

The Jenner Institute

Sarah Gilbert
Teresa Lambe
George Warimwe
Adrian Hill

University of Sydney

Alison Peel

Bernhard Nocht Institute

César Muñoz-Fontela

Indiana University

Ryan Relich

Yale

Craig Wilen

Mount Sinai MC

Adolfo Garcia-Sastre
Gustafo Palacios

NIH

Bob Seder
Karen Frank
Lori Dodd
Cristina Cassetti
Ranjan Mukul
Kimberly Stemple
Elodie Ghedin
Mark Pineda
Libby Higgs
Alicen Spaulding
Daniel Douek
Mike Holbrook
Connie Smaljohn
Sanchita Das
Jean Patterson
Tara Palmore
Jane Knisely
Johanna Schneider
Jeff Taubenberger
Joshua Tan
WCS
Sarah Olsen
Eeva Kuisma
Chriz Walzer
Alain Ondzie

Penn state

Nita Bharti

CSU

Tony Schountz
Dick Bowen
Lon Kendall

JUST

Ehab Abu-Basha
Ahmad M Al-Majali
Zaidoun S Hijazeen
Nadim Amarin

Johns Hopkins

Emily Gurley
Seth Judson

Erasmus MC

Marion Koopmans
Debby van Riel
Bart Haagmans

WSU

Stephanie Seifert

SAVE

Jacco boon
Pete Halfmann
Andy Pekocz
Mehul Suthar
Dan Baruch
Richard Webby
Michael Diamond
Yoshihiro Kawaoka
Diane Post
Erik Stemmy

NHPL – Brazzaville

Fabien Roche-Niama
Pémbé Mayengué
Félix Koukouikila-Koussounda

Montana Vet Diagnostic Lab

Erika Schwarz

University of Notre Dame

Kyle Bibby

University of Hong Kong

Malik Peiris
Leo Poon

Royal Veterinary College

Javier Guitian
Peter Holloway

INRB

Placide Mbala
Jean-Jacques Muyembe-Tamfum

Montana Fish Wildlife and parks

Jennifer Ramsay

University of North Carolina

Ralph Baric

Uniformed Services University

Chris Broder
Eric Liang

Kansas State University

Juergen A Richt

CZ Biohub

Amy Kistler

MSF

Armand Sprecher
Hilde De Clerck
Rob d'Hondt

EvergreenHealth

Francis Riedo

WHO

Maria van Kerkhove
Lorenzo Subissi

UCLA

Dylan Morris
Santiago Cardenas
Jamie Lloyd-Smith

Oxford University

Rhys Pryce
Thomas Bowden

University of Utah

Jeremiah Matson

Noguchi

Irene Offei Owusu
Koffi Bonney

FCRM

Francine Ntoumi

DIR

CEPI

DARPA

Astra Zeneca

Cepheid

Curevac

Orasure