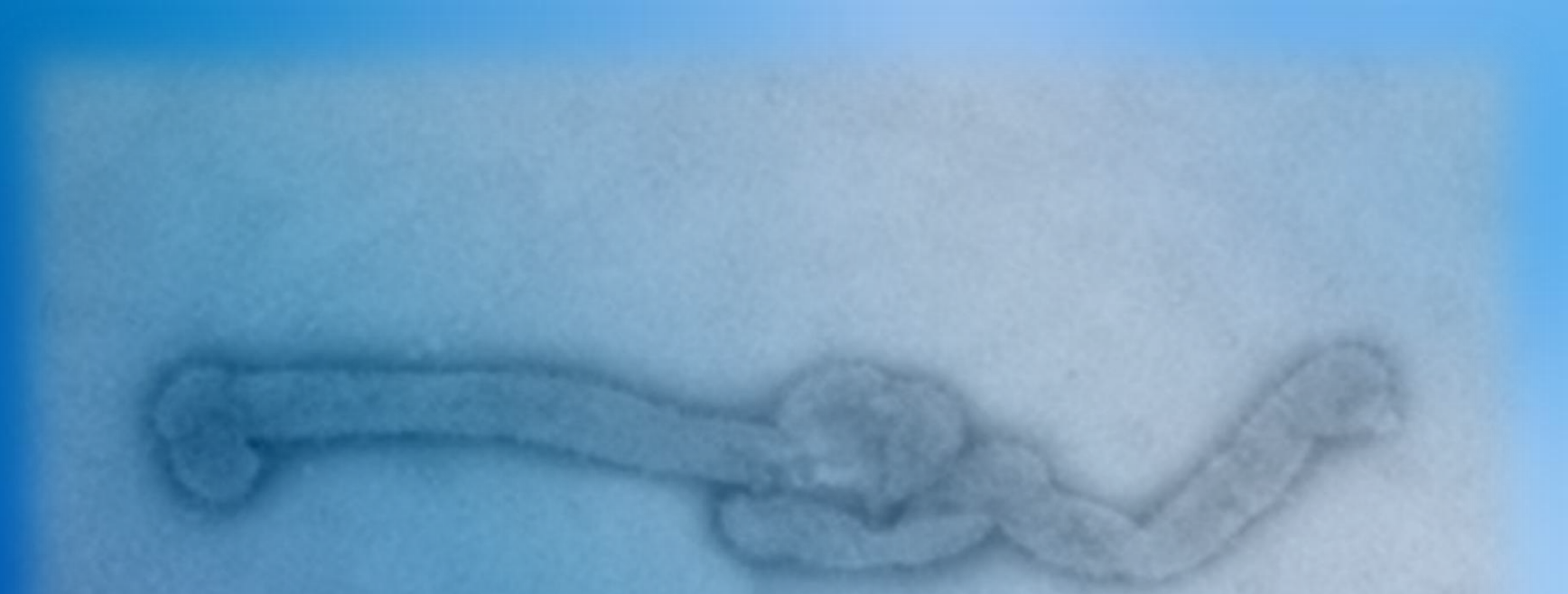

Beyond the Usual Suspects

Novel and Emerging Viruses in a Changing World

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Northeast Association for Clinical Microbiology and Infectious Disease
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- Financial disclosures
  - Consulting
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    - Pattern Bioscience

- No off-label or investigational use of commercial products will be discussed

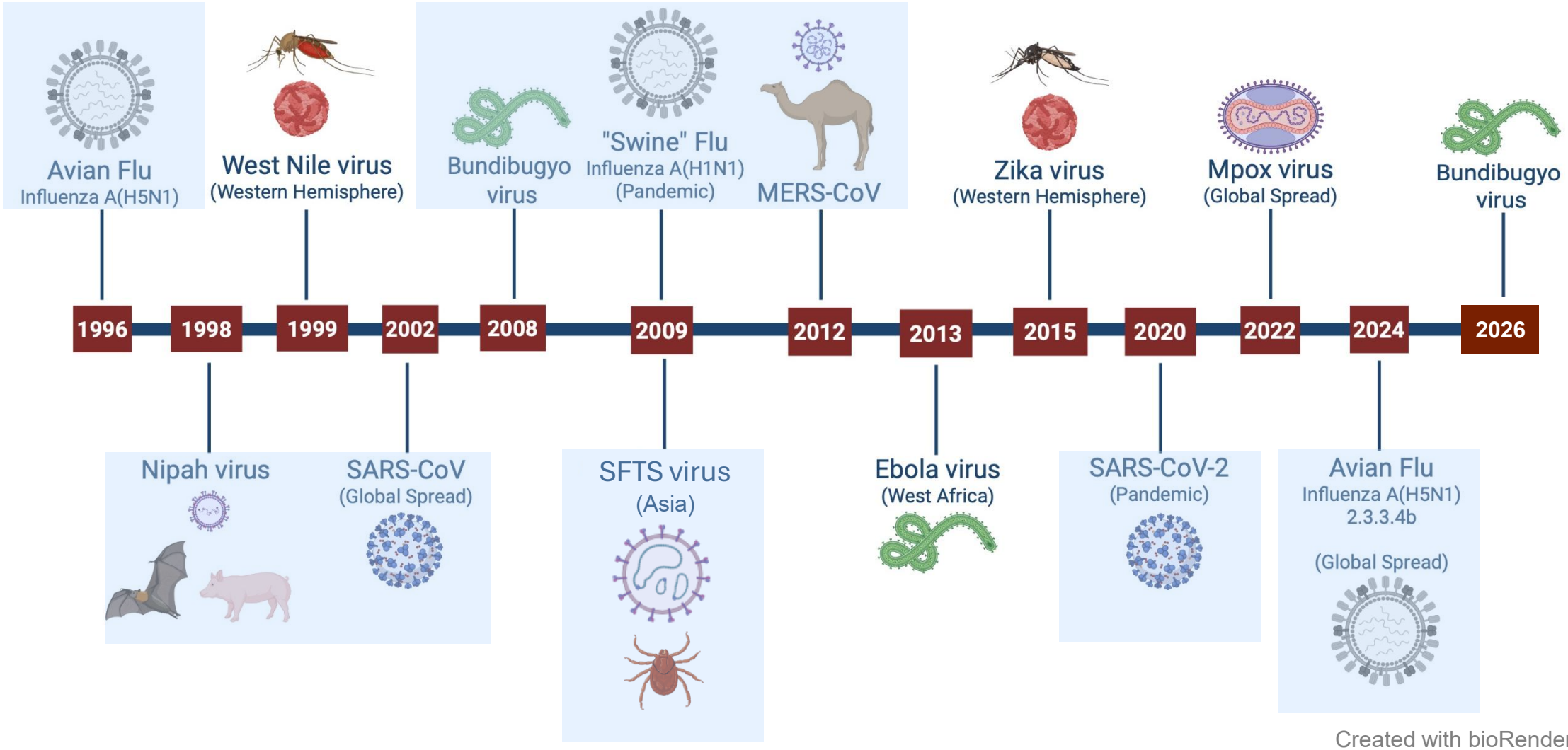
Presentation Objectives

- Describe the ecological, environmental, and societal drivers that contribute to viral emergence in a changing world
- Recognize key examples of recent novel and emerging viruses and the lessons learned from their detection and response
- Assess gaps in surveillance, diagnostics, and research that contribute to viruses being neglected
- Reflect on the implications of emerging viral threats for clinical practice, public health policy, and research priorities

What are novel and emerging viruses?

- **Novel viruses…**
  - Either new to science **or** known about but have recently surfaced in the human population
- **Emerging viruses…**
  - May be novel (or not), and are increasing in incidence or geographic range or have the potential to do so
- **There are also re-emerging viruses…**
  - Those that have resurfaced after periods of low incidence/prevalence (e.g., measles virus)

What are novel and emerging viruses?

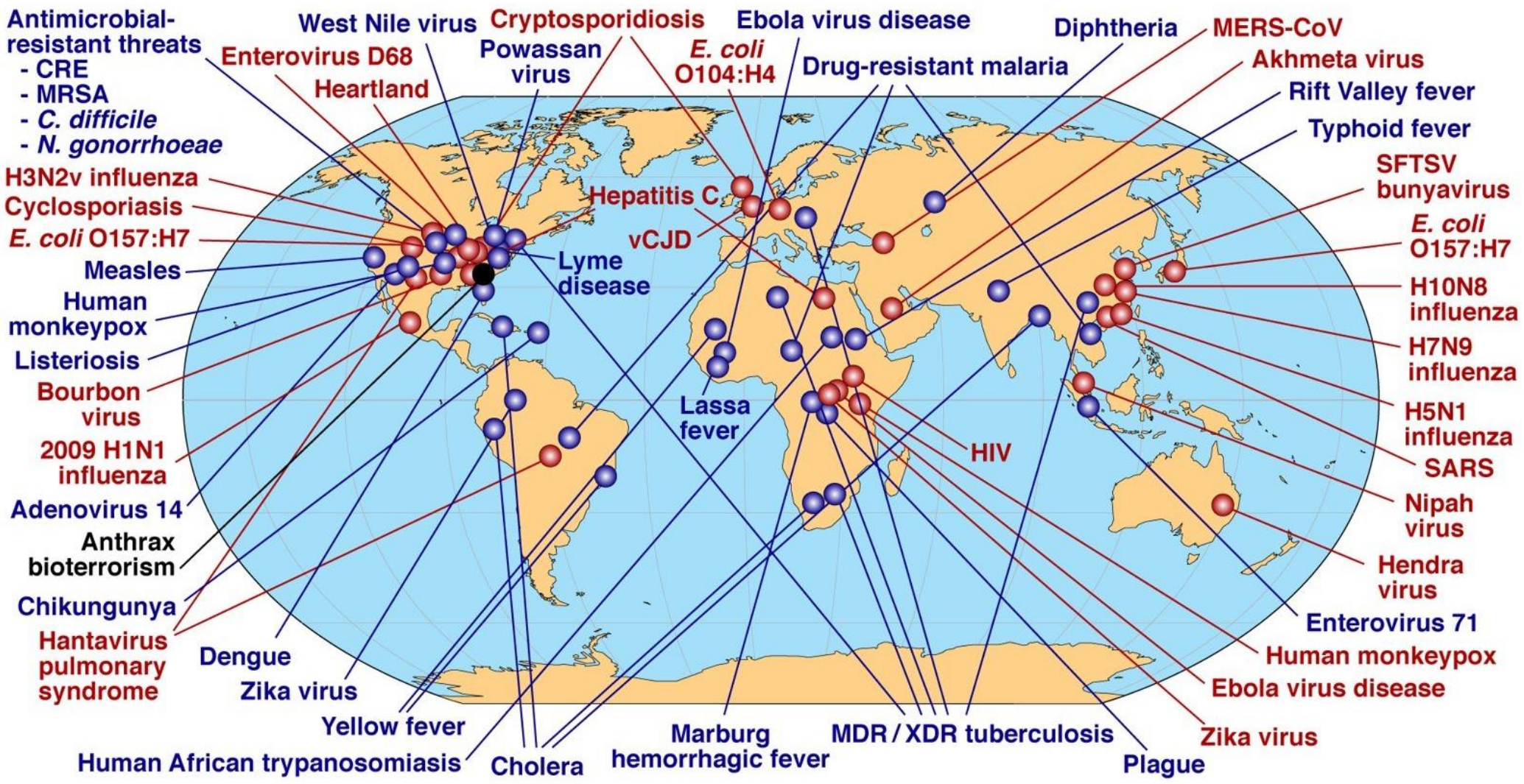


Created with bioRender.com

What are novel and emerging viruses?

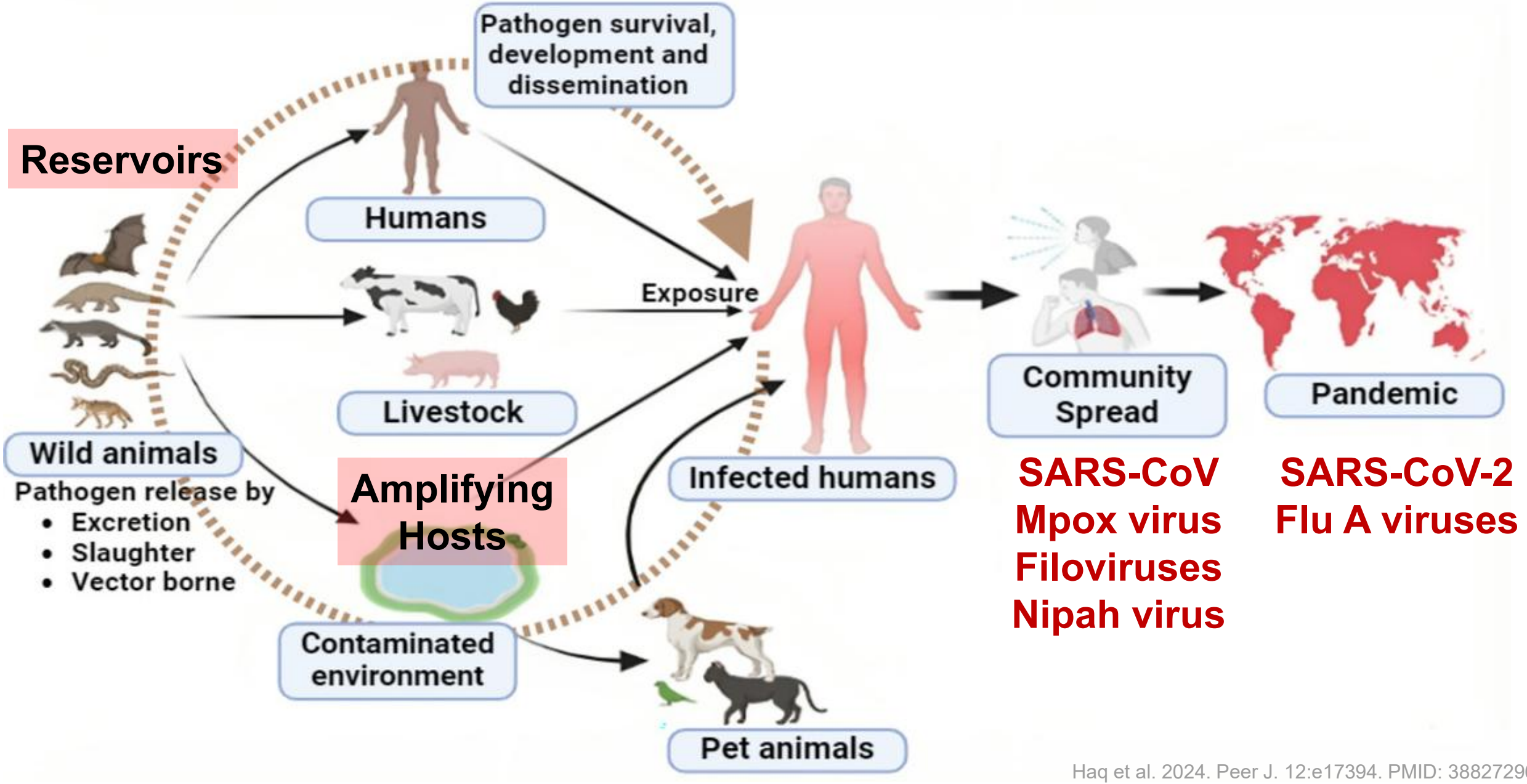
- **A few I left off the timeline…**
  - Heartland virus – 2009
  - Oz virus – 2013 (human disease link in 2023)
  - Bourbon virus – 2014
  - Langya virus – 2018
  - Non-H5 avian influenza A viruses
    - A(H7N9) – 2013
    - A(H5N5) – 2025
  - Asian longhorned tick nairovirus – 2026

Global Examples of Emerging and Re-Emerging Infectious Diseases



Where do these viruses come from?

- **Most originate in wild animals**
  - **Spillover** from reservoir species, intermediate hosts, and/or vectors precipitates human outbreaks



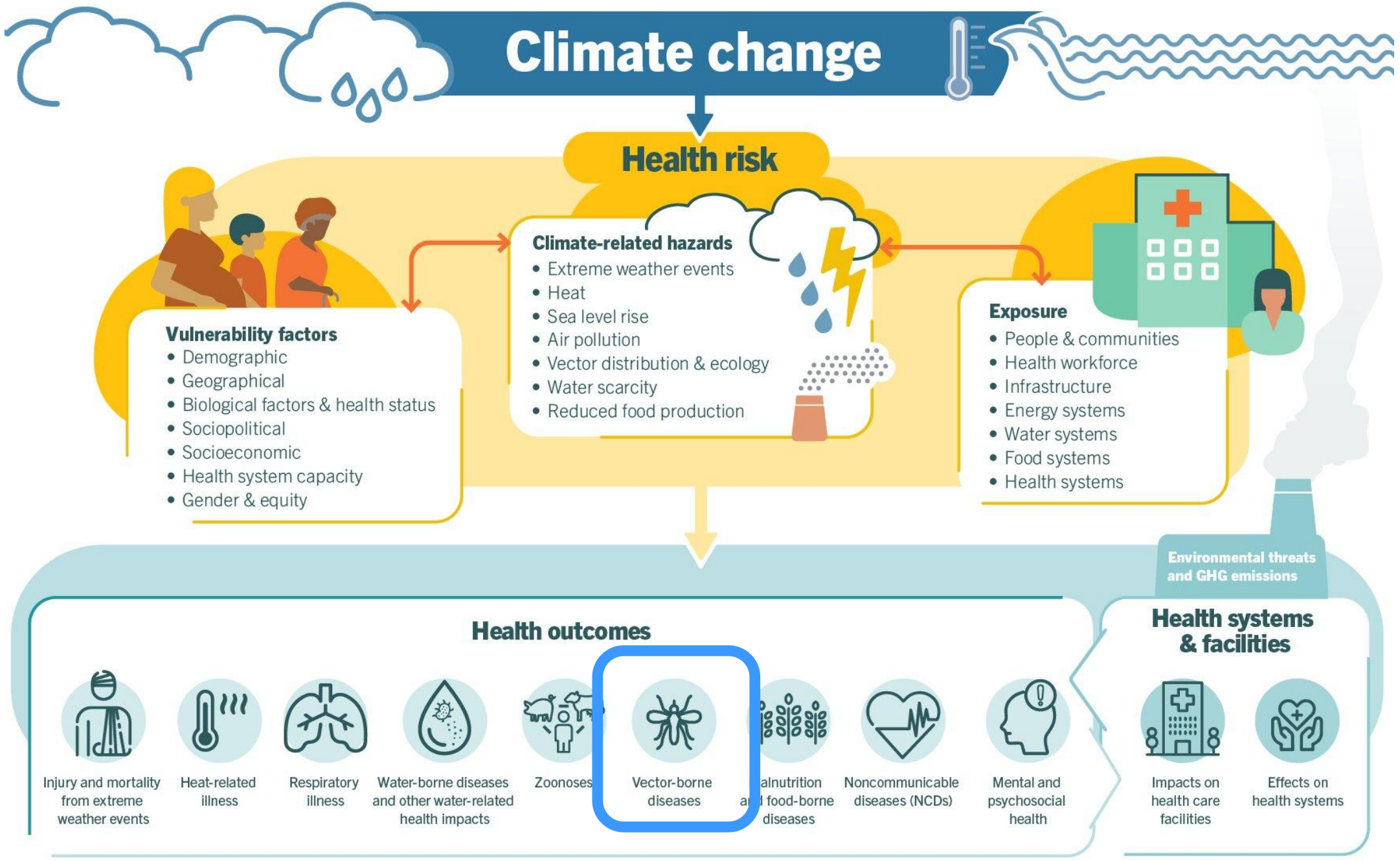
Haq et al. 2024. Peer J. 12:e17394. PMID: 38827296

What drives their emergence?

- **Ecological factors**
  - Human encroachment into natural areas, loss of biodiversity, land use
- **Environmental factors**
  - Climate change, expansion of viral vector habitats, extreme weather events, urbanization
- **Societal factors**
  - Trade and travel, population growth, conflict and displacement, healthcare inequities, waning herd immunity, misinformation

What drives their emergence?

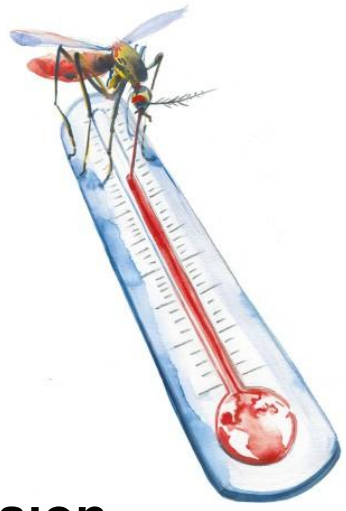
- **Example** – effects of climate change, deforestation, and land modifications on arboviruses



WHO

What drives their emergence?

- **Example** – effects of climate change, deforestation, and land modifications on arboviruses
  - Temperature affects extrinsic incubation of arboviruses
    - Extrinsic incubation = time between a vector becoming infected with and transmitting an arbopathogen
    - E.g., dengue virus
      - 2.4X increase in transmission rate with an ~10ºC increase*
    - **Increased temperatures do not necessarily favor increased transmission of all arbopathogens**

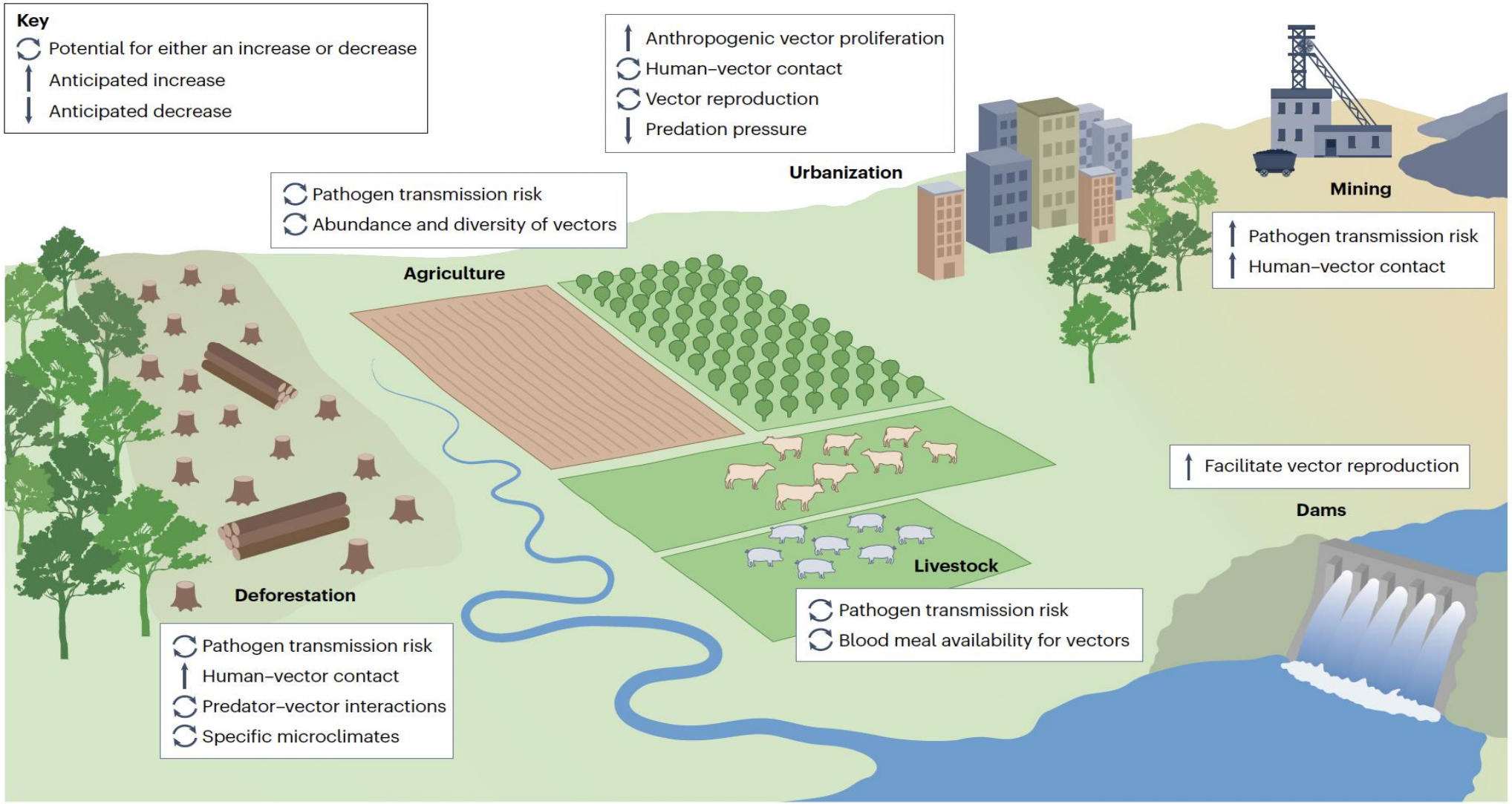


*Barbazan et al. 2010. Med Vet Entomol. 24(1):66-73. PMID: 20377733

What drives their emergence?

- **Example** – effects of climate change, deforestation, and land modifications on arboviruses
  - Arbovirus emergence is also influenced by
    - Humidity and surface moisture
    - Competent host populations
      - Reservoirs and intermediate hosts don’t live everywhere
    - Where and how humans live

What drives their emergence?



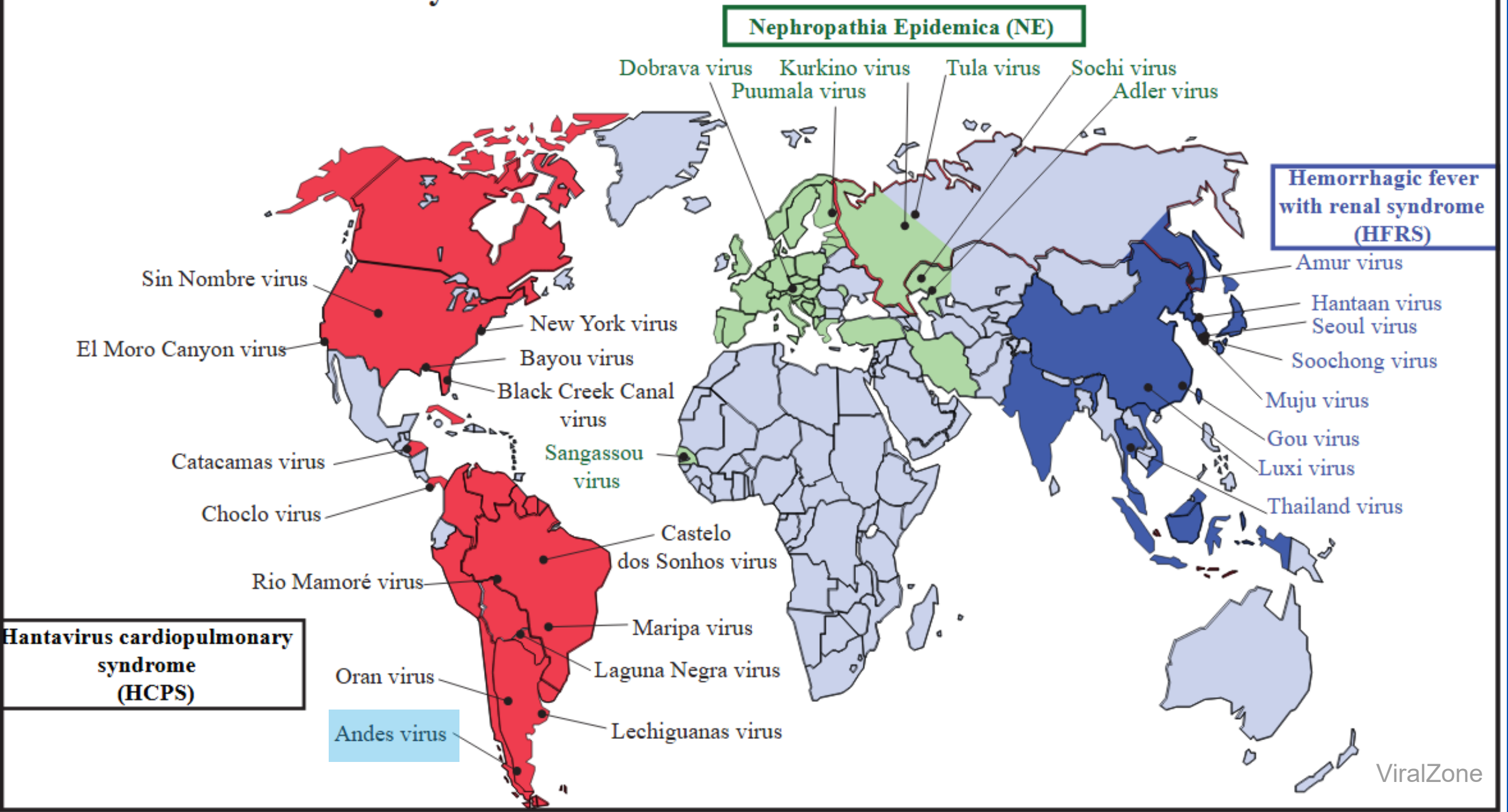
De Souza WM and Weaver SC. 2024. Nat Rev Microbiol. 22(8):476-491. PMID: 38486116

Let’s discuss a couple specific viruses

Andes virus (ANDV)

- **An orthohantavirus**
  - One of 38 currently known *Orthohantavirus* species
    - *Orthohantavirus andesense*[1]

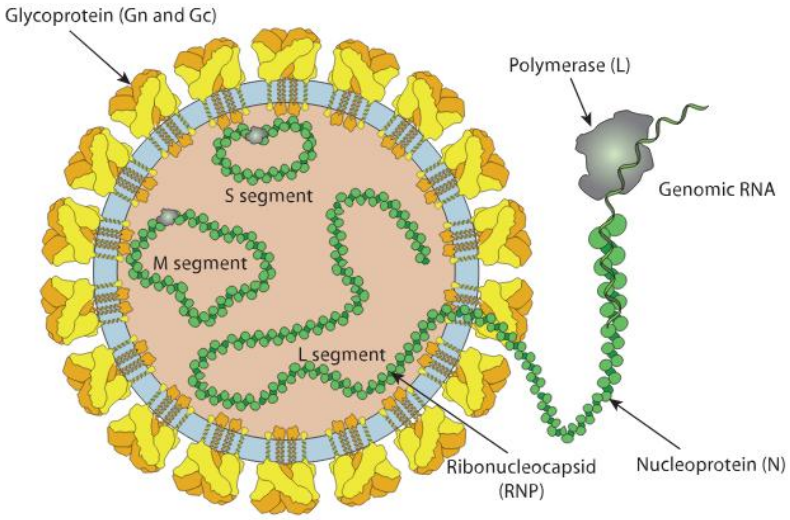
Diversity of Hantavirus and associated human diseases



Andes virus (ANDV)

- **An orthohantavirus**
  - One of 38 currently known *Orthohantavirus* species
    - *Orthohantavirus andesense*[1]

- **Tripartite, (-)ssRNA genome**
  - Genome encodes 5 proteins
  - Particles are enveloped and measure ~80 – 120 nm



ViralZone

Andes virus (ANDV)

- **Causes hantavirus (cardio)pulmonary syndrome (HPS or HCPS)**
  - Most common cause of HPS in South America
  - Endemic in Argentina and Chile
  - CFR, ~25 - 40%

- **Ecology and epidemiology**
  - Reservoir – long-tailed pygmy rice rat
    - *Oligoryzomys longicaudatus*
  - Human infections usually result from rodent or rodent excrement exposure
  - **Human-to-human transmission**

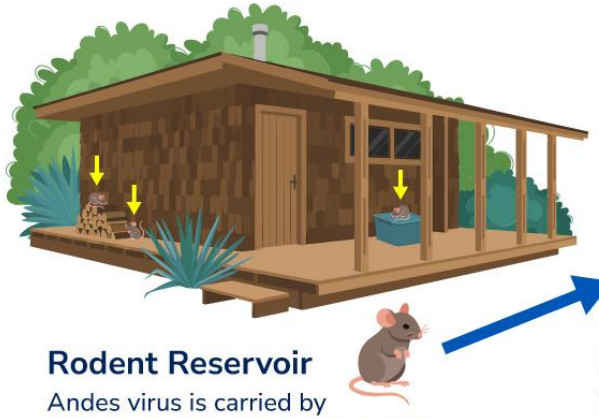
Wikiwand

Andes virus (ANDV)

How Andes Virus Spreads

Andes virus is a hantavirus carried by wild rodents in parts of South America. People can become infected after exposure to infected rodents, and in rare situations, Andes virus can spread between people through close contact with someone who is sick.

Main Way it Spreads



Rodent Reservoir

Andes virus is carried by long-tailed rice rats found in parts of Argentina and Chile. Infected rodents can shed virus in urine, droppings, and saliva.

Environmental Exposure

People can become infected when they breathe in dust contaminated with urine, droppings, or saliva from infected rodents, especially in enclosed or poorly ventilated spaces. Rarely, it can also spread through a bite or scratch by a rodent.

Illness and Infectious Period

Symptoms usually appear **4-42** days after exposure. Early symptoms can include fever, fatigue, muscle aches, headache, dizziness, chills, nausea, vomiting, diarrhea, or abdominal pain. Some people later develop cough and shortness of breath.

Rare Way it Spreads

Limited Person-to-Person Spread

Andes virus is the only hantavirus known to spread person to person. **This spread is rare and usually requires close contact with someone who has symptoms.**

Andes virus (ANDV)

- **April – May 2026**
  - ANDV’s rise from obscurity

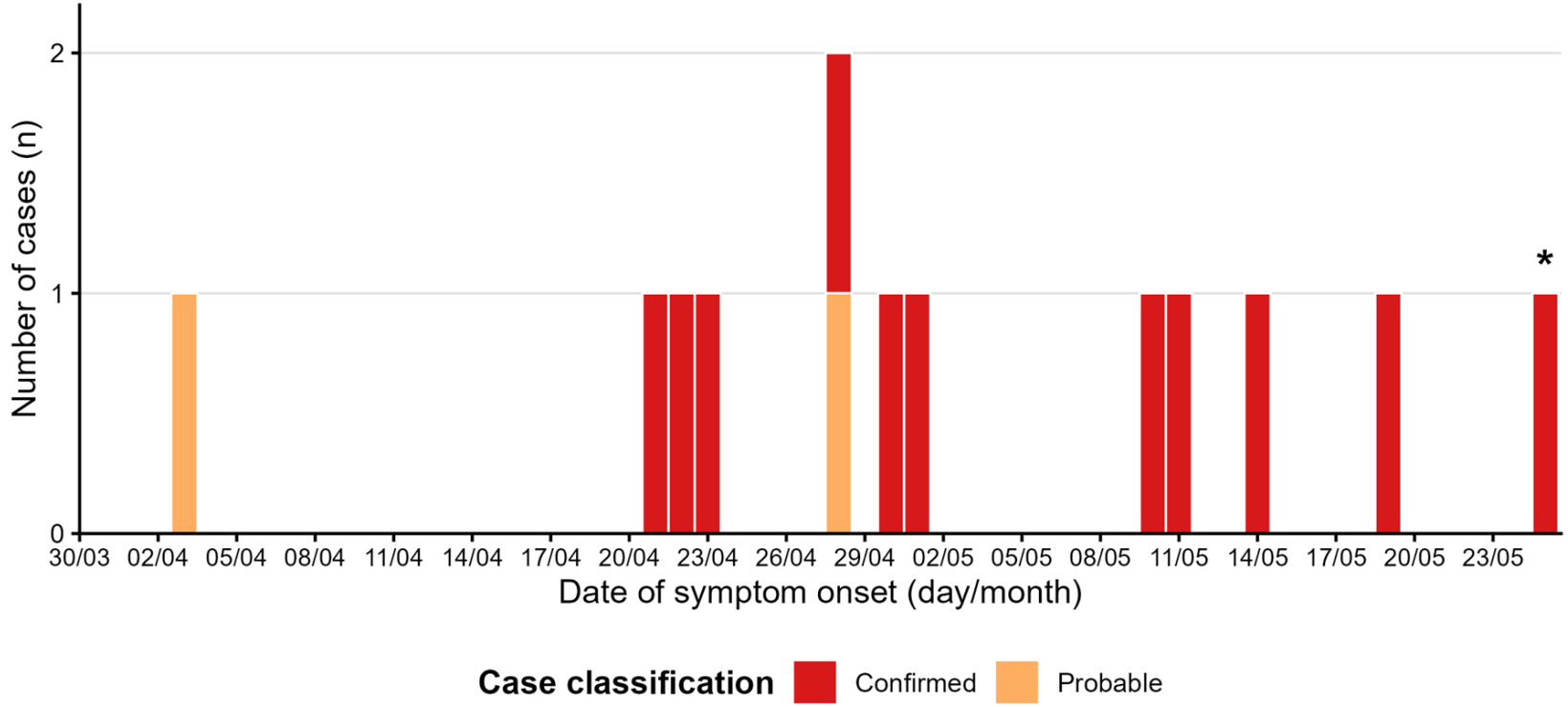
NBC NEWS + Follow 2.3M Followers

What is the Andes virus? The hantavirus linked to a cruise ship outbreak is the most deadly strain

M/V Hondius
Wikipedia

Andes virus (ANDV)

- **April – May 2026**
  - ANDV's rise from obscurity



*Case is asymptomatic so shown by date of reporting

WHO

Bundibugyo virus (BDBV)

- **Pronunciation** – *BOON-dee-BOO-djyo*

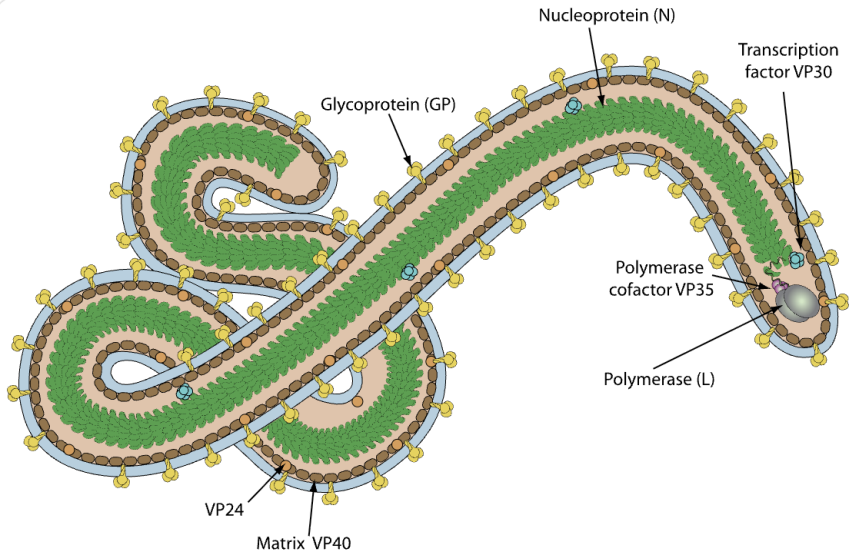
- **BDBV is an orthoebolavirus**
  - One of 6 currently known *Orthoebolavirus* species
    - *Orthoebolavirus bundibugyoense*[1]

  - One of 4 orthoebolaviruses known to cause **Ebola disease**
    - Ebola virus > Sudan virus > Bundibugyo virus > Taï Forest virus

[1]2025 ICTV taxonomy release

Bundibugyo virus (BDBV)

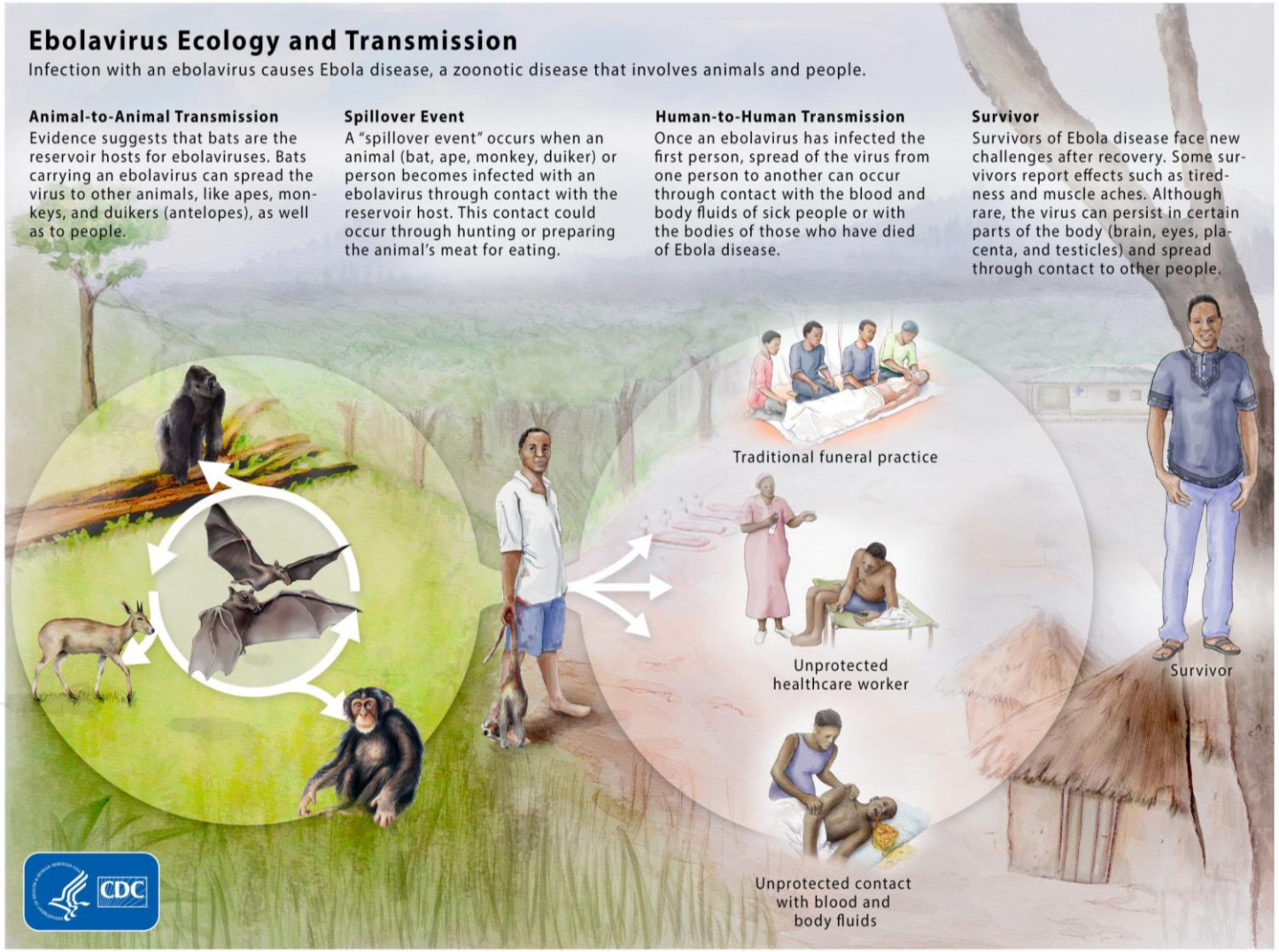
- **Like other filoviruses, BDBV comprises**
  - Linear, monopartite (-)ssRNA genome
    - Encodes 7 proteins
  - Filamentous, enveloped particles
- **Three recorded outbreaks**
  - 2007-2008 – Bundibugyo District, Uganda
  - 2012 – Province Orientale, DRC
  - 2026 – Eastern DRC and Uganda



ViralZone

Bundibugyo virus (BDBV)

- **Postulated ecology and epidemiology**
  - Reservoir – bat (?)
  - Spillover to humans from animal exposure
    - Subsequent human-to-human transmission



Bundibugyo virus (BDBV)

- **May 5, 2026**
  - Several cases of an unknown, high-mortality disease reported in Ituri Province, DRC
    - Confirmed to be BDBV disease on May 15
  - Uganda Ministry of Health reported an outbreak of BDBV disease at the same time
    - One fatal case reported in Kampala → person from DRC

Bundibugyo virus (BDBV)

- **Fast forward to September 12, 2026**
  - Confirmed cases and deaths (data from CDC)

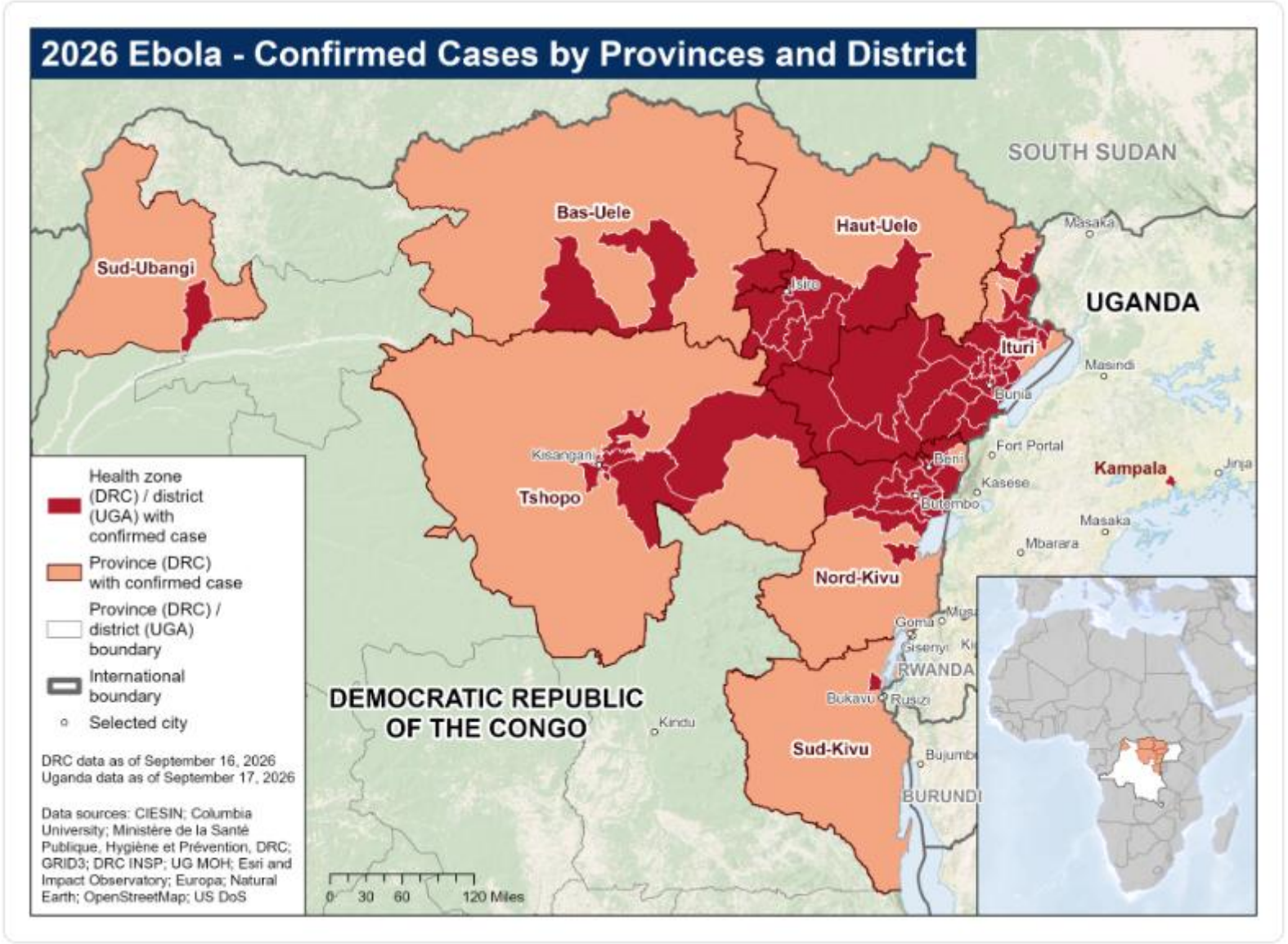
Country	Confirmed Cases	Confirmed Deaths	CFR
DRC	7,200	3,475	48%
Uganda	20	2	10%
France	1	0	0%

  - This likely does not represent the true number of cases in DRC

Bundibugyo virus (BDBV)

- **This is a very challenging outbreak to manage**
  - Ongoing regional conflict and violence against healthcare workers
  - Limited or complete lack of medical supplies, including PPE, diagnostics, supportive therapies, etc.
  - Frequent population movement to and from the area
  - Misinformation and lack of trust in the government

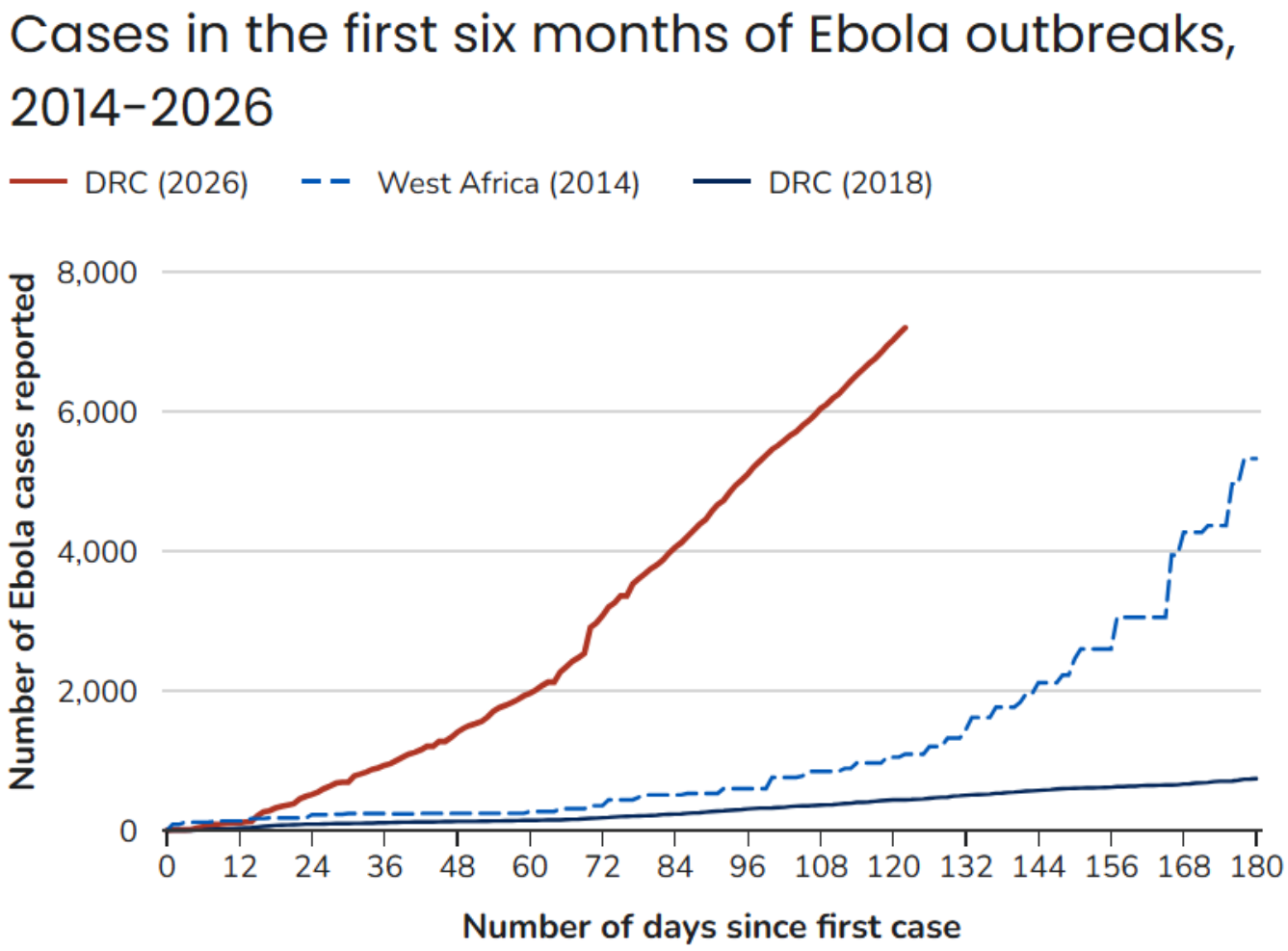
Bundibugyo virus (BDBV)



Bundibugyo virus (BDBV)

- **When will this outbreak be controlled?**
  - Currently, it's difficult to determine
  - Contact tracing, infection control and prevention, and other response and containment measures are nearly impossible in some areas
  - Some speculate this outbreak could continue for >1 year
    - It is already the second largest Ebola disease outbreak in history

Bundibugyo virus (BDBV)



*Cases shown based on date reported. Data Sources: DRC INSP, WHO. Data for DRC (2026) are as of 2026-09-13.

Bundibugyo virus (BDBV)

- **Are there treatments and preventive measures being developed?**
  - Several treatments, including monoclonal antibody therapies and vaccine candidates, are being evaluated

Implications for clinical practice and public health

- *What can we do to protect ourselves from future threats?*

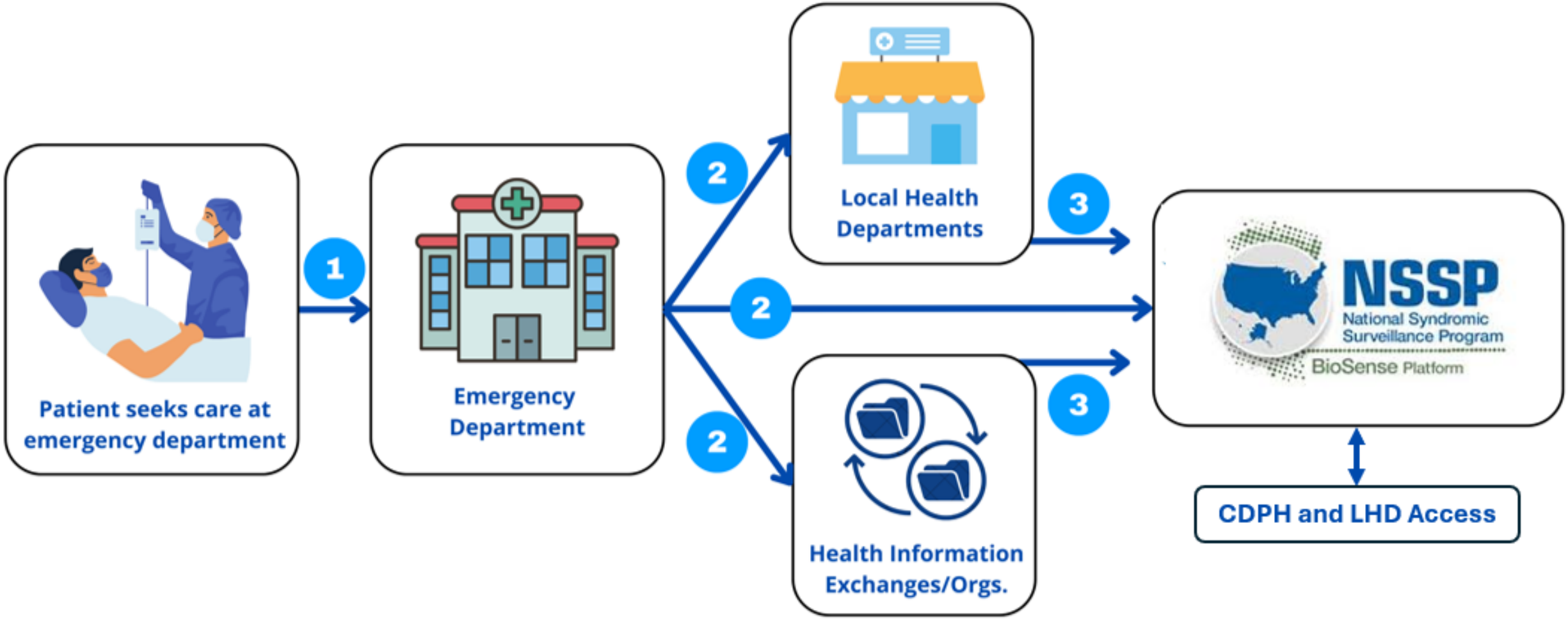
Taking action against novel and emerging viruses

- **Monitoring and early detection**
  - **Surveillance**
    - Passive – reporting cases to public health agencies
      - Notifiable disease surveillance systems
      - May not find every case
    - Active – public health agencies actively engage and act
      - The idea is to find every case
      - Requires significant personnel and financial resources

Taking action against novel and emerging viruses

- **Monitoring and early detection**
  - **Surveillance**
    - Syndromic surveillance – disease indicators are electronically monitored

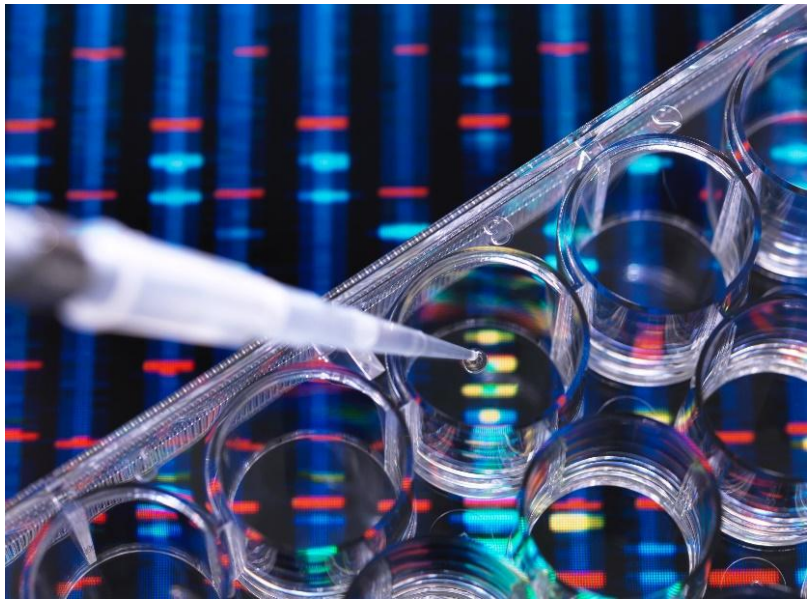
Taking action against novel and emerging viruses



California Department of Public Health

Taking action against novel and emerging viruses

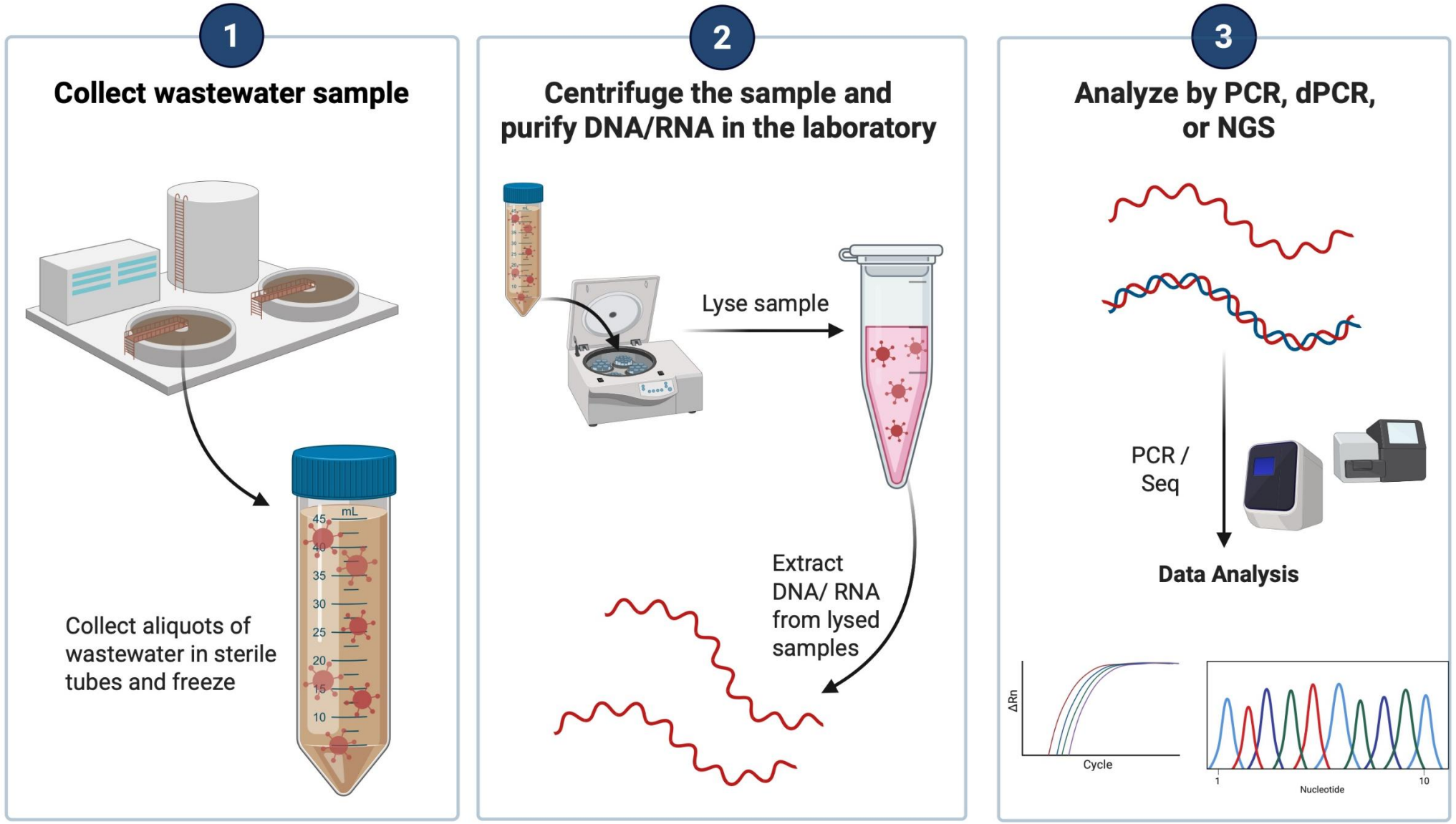
- **Monitoring and early detection**
  - **Surveillance**
    - Genomic surveillance – continuous monitoring of pathogens via genetic analysis
      - E.g., variant surveillance of SARS-CoV-2



Taking action against novel and emerging viruses

- **Monitoring and early detection**
  - **Surveillance**
    - Environmental surveillance – wastewater analysis
      - SARS-CoV-2
      - Influenza A(H5N1)
      - Mpox virus
      - Poliovirus

Taking action against novel and emerging viruses



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Taking action against novel and emerging viruses

- **Monitoring and early detection**
  - **Technology and innovation**
    - Leveraging AI – analysis of the mountains of data
    - Predictive modeling – create forecasts using historical data
    - Digital health tools – apps for electronic devices
    - Real-time reporting – faster clinical and public health interventions

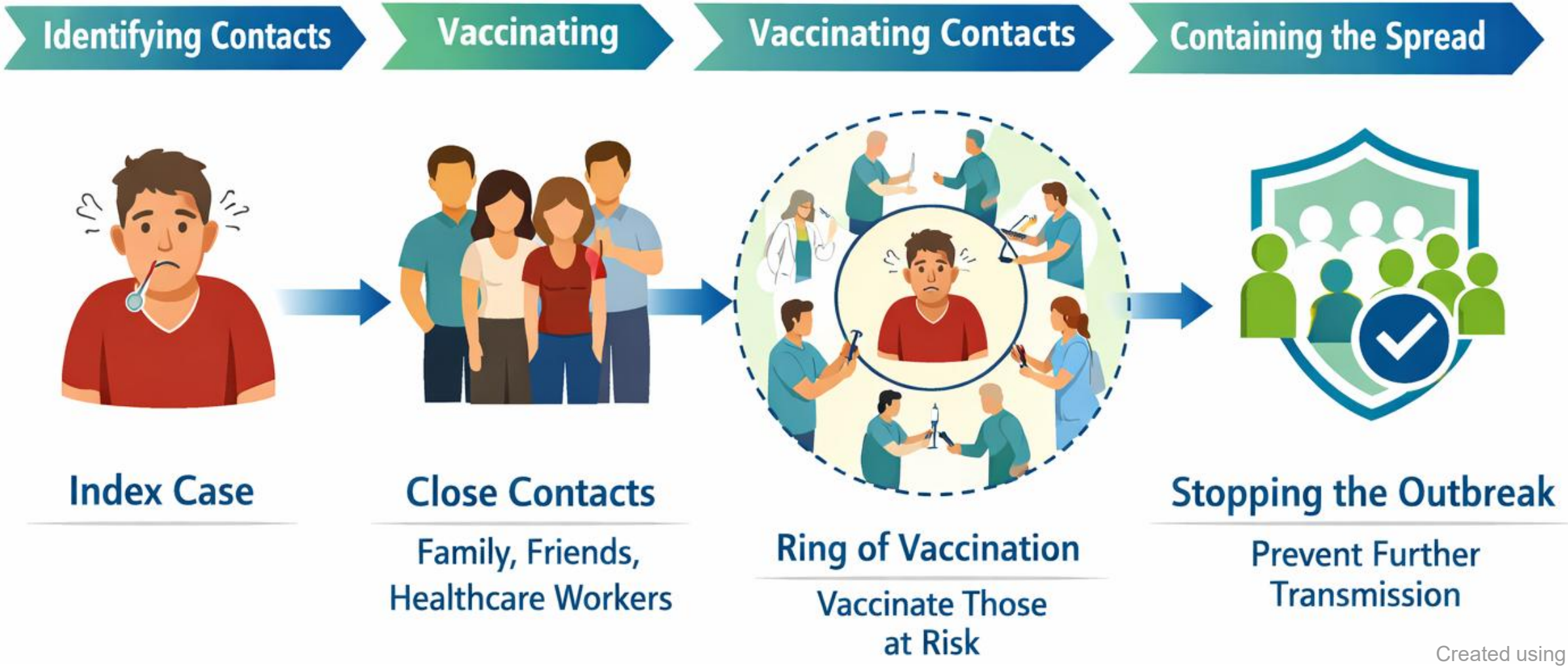
Taking action against novel and emerging viruses

- **Monitoring and early detection**
  - **Global collaboration**

Taking action against novel and emerging viruses

- **Rapid response strategies**
  - Testing
    - Rapid, high-volume testing capacity
    - Point-of-care and at-home testing availability
  - Contact tracing
  - Isolation
  - Vaccination campaigns – *if a vaccine exists*

Taking action against novel and emerging viruses



Created using AI

Taking action against novel and emerging viruses

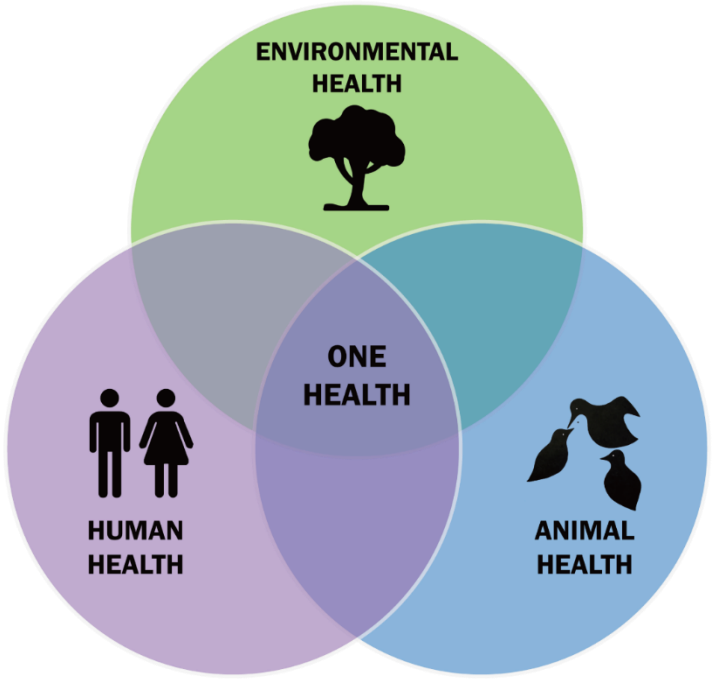
- **Health system preparedness**
  - Capacity building
    - Testing
    - Workforce
    - Supply chains
  - Infrastructure resilience
    - Ensuring continuity of essential services following disruptions

Taking action against novel and emerging viruses

- **Mitigation**
  - Establish robust readiness and response systems for dealing with future infectious disease outbreak
    - Surveillance networks
    - Supply chains
    - Infectious disease research
    - Predictive analytics
    - Improving healthcare infrastructure and availability of medicines and vaccines
    - Heightened biosecurity

Taking action against novel and emerging viruses

- **Mitigation**
  - One Health approach
    - Collaborative, multisectoral, and transdisciplinary approach
    - Aims to achieve optimal human, animal, plant, and ecosystem health
  - *Humans, animals, and ecosystems are connected*



Taking action against novel and emerging viruses

- **Mitigation**
  - Surveilling ecosystems, animals, and human populations for (re)emerging pathogens
  - Development of sustainable infrastructure for outbreak prediction and response, countermeasure development, and disease prevention
  - Educating communities about disease signs/symptoms, prevention, etc.

Taking action against novel and emerging viruses

- **Long-term prevention**
  - Developing robust responses
    - Vaccine and therapeutic development and deployment pipelines
    - Vector control programs
    - Education programs
  - International policy and governance
  - Funding and political commitments

Challenges and barriers

- **Public distrust and misinformation**
- **Inequities in global health access**
- **Data gaps and underreporting**
- **Political and economic constraints**

Future directions

- **Strengthening global surveillance networks and investing in early warning systems**
- **Climate-informed disease modeling**
- **Capacity building for diagnostics and countermeasures**
- **Prioritizing pandemic preparedness as a national security concern**

Take-home points

- **Viral emergence is driven by interconnected ecological, environmental, and societal changes**
- **Presently obscure and unknown viruses may pose significant threats**
- **Surveillance and diagnostics determine what we recognize and what remains invisible**
- **One Health approaches are essential for prevention and response**
- **Clinicians, researchers, and public health professionals all have critical roles in identifying and responding to emerging viral threats**

Thank you for the opportunity to speak!