Hantavirus: A Global Strategic Framework for Preparedness

Why Hantavirus Warrants Attention Now

A zoonosis causing an estimated 100,000–200,000 clinical cases a year is being pushed into new human interfaces by environmental change.

100,000–200,000

Estimated clinical cases annually,
with substantial underdiagnosis likely

>50

Hantavirus species identified globally;
only a subset cause human disease

2

Distinct clinical syndromes:
HFRS (Eurasia) and HCPS (Americas)

Drivers of rising global significance

- **Environmental change**
- **Urban expansion**
- **Climate variability**
- **Agricultural intensification**
- **Population displacement**

Strategic imperative: strengthened surveillance, laboratory capacity, and integrated One Health approaches.

One Virus, One Reservoir, Lifelong Shedding

Each hantavirus is locked to a distinct small-mammal reservoir that is persistently infected but never sick — so epidemiology follows rodent ecology, not human transmission chains.

Virology and taxonomy

- Family Hantaviridae, order Bunyavirales
- Enveloped, negative-sense single-stranded RNA viruses
- More than 50 species identified globally; only a subset are known to cause human disease

Host specificity

- Each species is typically associated with a distinct rodent or small-mammal reservoir
- The reservoir carries a persistent infection without overt disease — an asymptomatic, lifelong source
- Shedding occurs in urine, feces, and saliva, enabling environmental contamination

Reservoir-to-human pathway

Hantavirus is a severe, environmentally driven zoonotic threat requiring urgent integration into Africa's health security frameworks.

The Threat Profile:

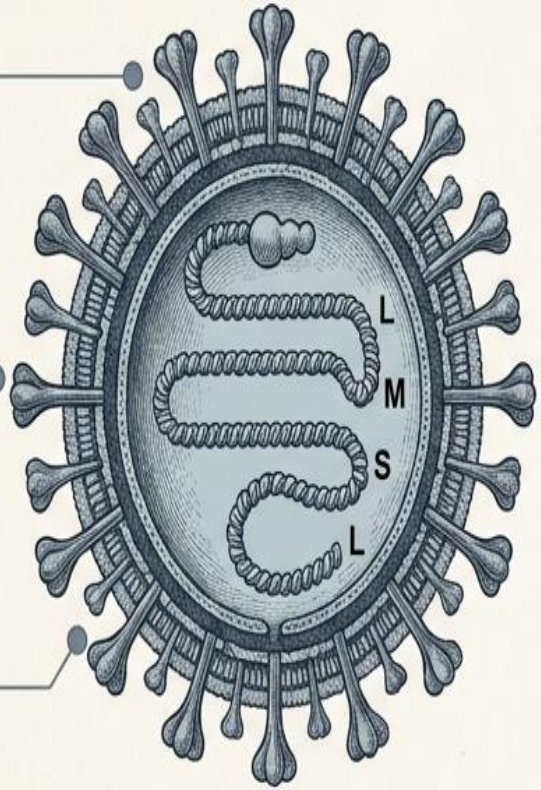
Zoonotic, enveloped, negative-sense ssRNA viruses (Order: Bunyavirales, Family: Hantaviridae).

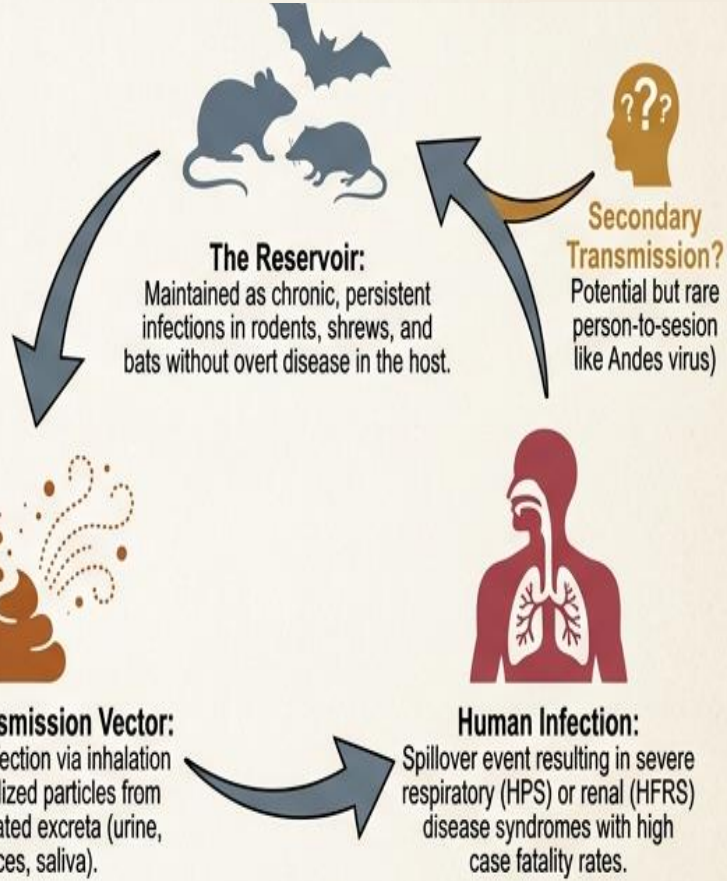
The Strategic Mandate:

Environmental change and urban expansion are accelerating spillover; driving an urgent need for One Health surveillance.

Key Characteristic:

Possesses a tripartite segmented genome that allows for genetic reassortment, contributing to high genetic diversity.





Reservoir Dynamics and Environmental Persistence

Over 50 species of Hantavirus exist globally, tightly co-evolved with specific small mammal reservoirs that chronically shed the virus into human environments.

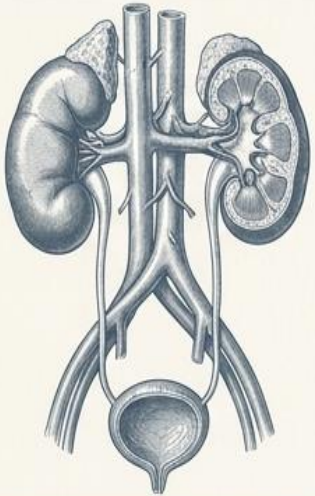
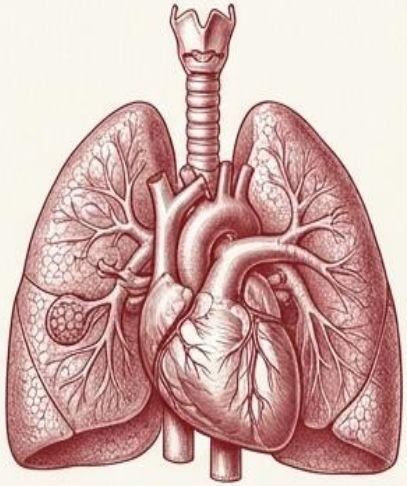
Expanding Host Range: Originally thought restricted to rodents; now conclusively identified in broader ecological niches, including shrews and bats.

Environmental Shedding: Continuous shedding of urine, feces, and saliva creates localized biohazards in enclosed spaces and agricultural settings.

The Wild | The Interface | The Human Domain

The Pathological Divide: Old World vs. New World

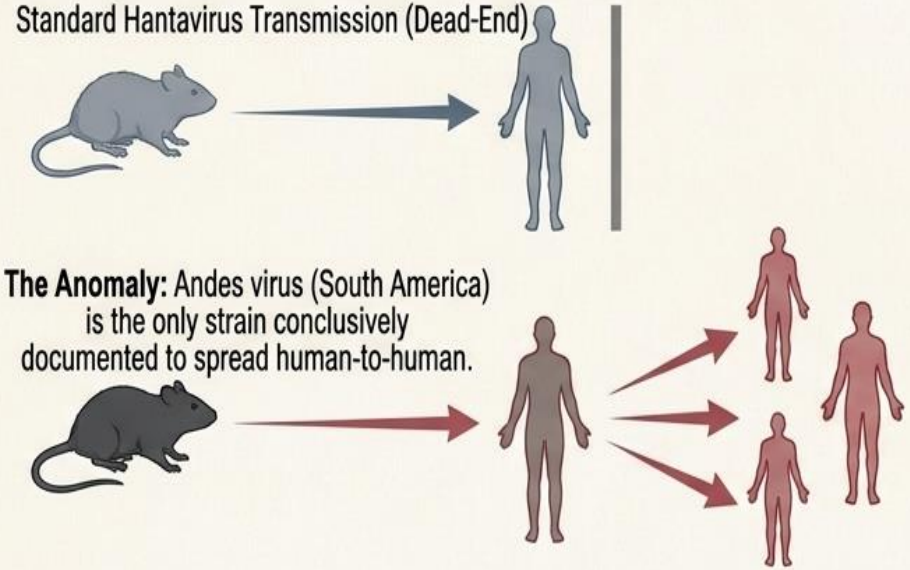
Hantavirus manifests in two distinct, geographically separated clinical syndromes:
HFRS (renal/hemorrhagic) and HCPS (pulmonary/cardiac).

Old World: Hemorrhagic Fever with Renal Syndrome (HFRS)	New World: Hantavirus Cardiopulmonary Syndrome (HCPS)
	
• **Geographies:** Europe & Asia • **Key Pathogens:** Hantaan, Seoul, Dobrava-Belgrade, Puumala. • **Pathology:** Endothelium and kidney damage, acute kidney injury, hemorrhagic manifestations, hypotension. (Note: Puumala causes milder Nephropathia epidemica).	• **Geographies:** Americas • **Key Pathogens:** Sin Nombre, Andes, Laguna Negra. • **Pathology:** Pulmonary edema, rapid respiratory failure, cardiogenic shock.

The Andes Virus Exception: A Threat Multiplier

Andes virus breaks the standard Hantavirus rule by enabling human-to-human transmission, highlighting the potential for nosocomial amplification.

Transmission Vector:
Requires prolonged, intimate, or household contact, especially during the prodromal phase.



Strategic Implication:
Raises severe concerns for outbreak amplification and nosocomial (hospital-acquired) spread.

High-Mortality Profile:
Rapid clinical deterioration requiring intensive care and mechanical ventilation.

Burden Is Concentrated — and Systematically Undercounted

Asia carries the overwhelming majority of global HFRS, the Americas contribute low-incidence but highly lethal HCPS, and Africa contributes almost no data at all.

ASIA

Largest global burden of HFRS

- China: approximately 70–90% of reported global cases
- Historically >100,000 cases/year in the 1980s–1990s; declined with improved housing, rodent control, vaccination, and surveillance
- Several thousand cases still occur annually in rural provinces
- Republic of Korea: endemic; military personnel, agricultural workers, rural populations

EUROPE

Thousands of infections annually

- Concentrated in northern and central Europe: Finland, Sweden, Germany, Belgium, France
- Puumala virus circulating among bank voles
- Mostly nephropathia epidemica (milder HFRS); severe disease can occur
- Mild winters and mast years drive rodent surges and periodic outbreaks

THE AMERICAS

Rare but highly lethal

- United States: >800 confirmed cases since the 1993 Sin Nombre outbreak; CFR ~35–40%
- Endemic: Argentina, Chile, Brazil, Paraguay, Bolivia, Panama
- South America: high mortality; limited secondary transmission with Andes virus
- Rapid deterioration; often requires ICU and mechanical ventilation

AFRICA

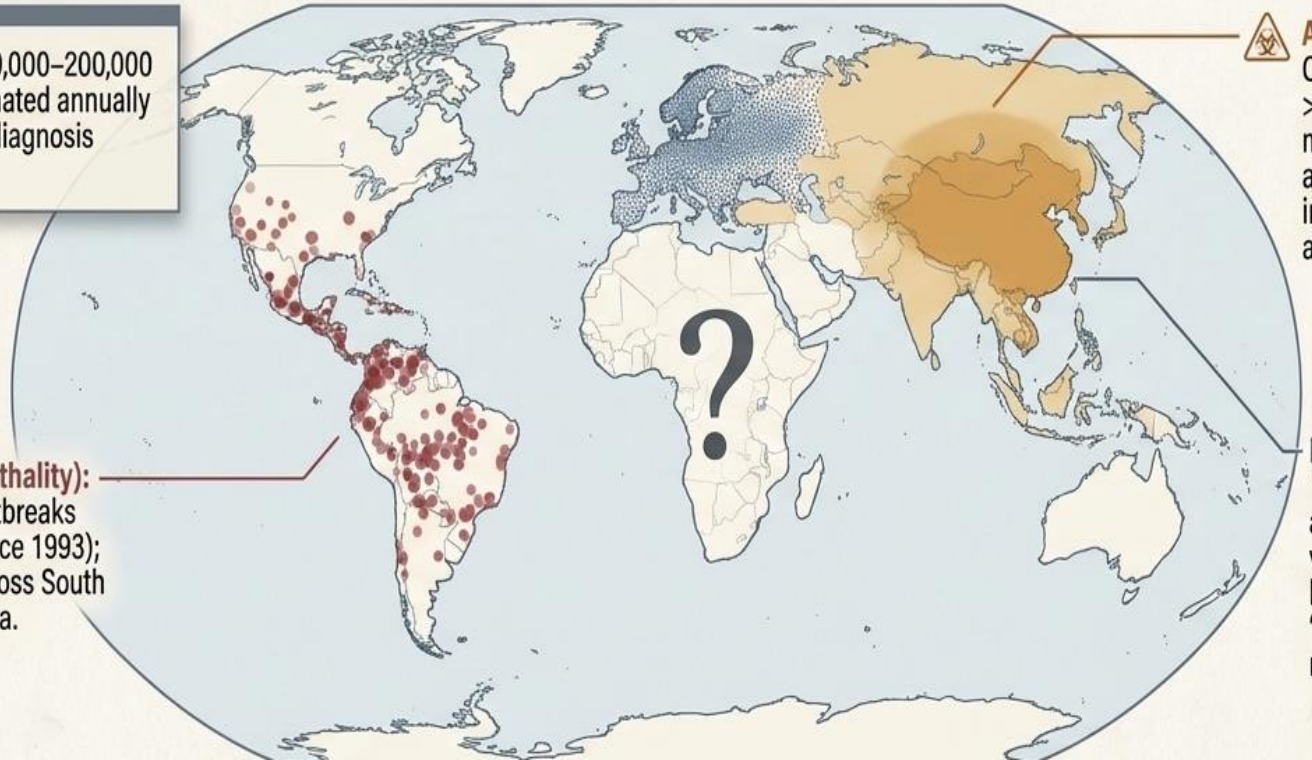
Limited, fragmented, substantially underestimated

- Serological evidence documented in Côte d'Ivoire, Guinea, Senegal, Nigeria, DRC, Ethiopia, Kenya, Madagascar, South Africa
- Rodent reservoirs identified in West, Central, and East Africa
- True burden: unknown

The Global Epidemiological Footprint

With up to 200,000 cases annually, Hantavirus exhibits distinct regional patterns—yet the African burden remains a glaring blank spot.

Global Burden: 100,000–200,000 clinical cases estimated annually (substantial underdiagnosis acknowledged).



Americas (High Lethality): Rare but severe outbreaks (>800 US cases since 1993); highly endemic across South and Central America.

Asia (Highest Volume): China historical highs >100,000/yr; now mitigated by housing and vaccines. Endemic in ROK affecting military and agricultural workers.

Europe (Climate-Driven): Thousands of infections annually (e.g., Puumala virus in bank voles), heavily influenced by "mast years" and mild winters.

Exposure Is Environmental, Not Interpersonal

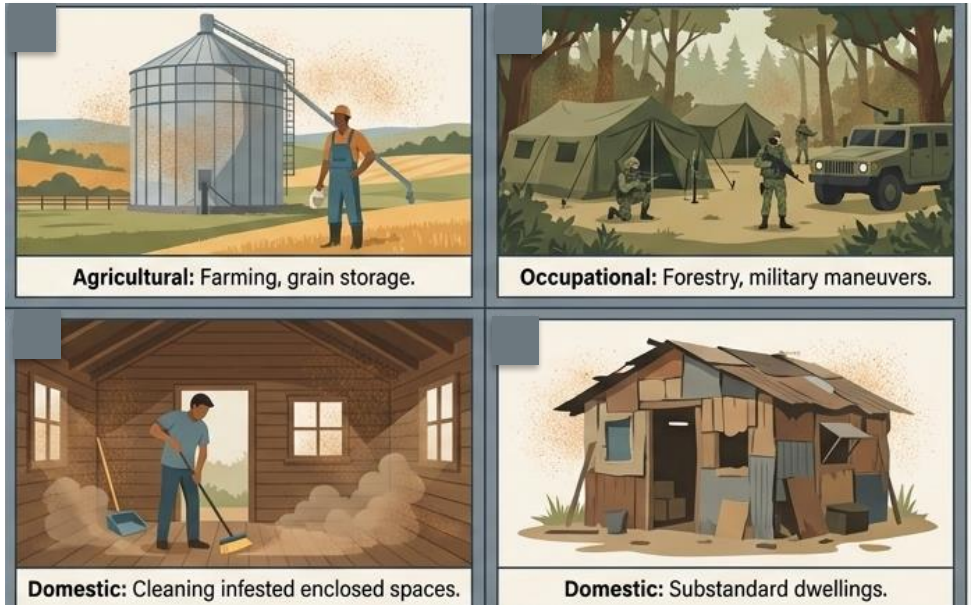
For every hantavirus except Andes, risk is defined by where people breathe rodent-contaminated air — which makes exposure a housing, occupation, and land-use problem.

PRIMARY ROUTE

- **Inhalation of aerosolized particles**
- **contaminated with rodent excreta**

SECONDARY ROUTES

- Direct contact with contaminated materials
- Rodent bites
- Mucous membrane contamination



High-risk exposure settings

1. Cleaning rodent-infested enclosed spaces
2. Farming and grain storage
3. Forestry and military activities
4. Occupational exposure in rural settings
5. Poor housing and sanitation
6. Sleeping in rodent-infested dwellings

Human-to-human transmission: conclusively documented only for Andes virus, requiring prolonged close contact.

Pathophysiology: Endothelial Dysfunction and Capillary Leak

Severe disease is driven by systemic vascular damage rather than direct viral cytopathology.

Mechanism

Severe endothelial dysfunction leads to massive capillary leakage.

HFRS

Results in hypotension, thrombocytopenia, and acute kidney injury.

HCPS

Leads to pulmonary edema, hypoxia, and cardiogenic shock within 24–48 hours.

A Long Latency, Then a Very Narrow Window

A 1–8 week incubation gives way to a non-specific prodrome and then diverges — with HCPS deteriorating within 24 to 48 hours.

INCUBATION

1–8 weeks

Silent, no clinical signal

EARLY SYMPTOMS — NON-SPECIFIC

Fever · headache · myalgia · fatigue · dizziness · nausea · vomiting · abdominal pain

PATHOPHYSIOLOGY

Severe disease is associated with endothelial dysfunction, capillary leakage, and multiorgan involvement.

Then the course diverges

HCPS / HPS — rapid deterioration within 24–48 hours

- Severe cough and dyspnoea
- Pulmonary oedema
- Hypoxia
- Cardiogenic shock
- Respiratory failure

HFRS — renal and haemorrhagic progression

- Hypotension
- Thrombocytopenia
- Haemorrhagic manifestations
- Acute kidney injury
- Oliguria followed by polyuria

The Differential Is the Bottleneck

Hantavirus resembles almost everything else that causes fever in endemic settings, so confirmation depends on exposure history plus laboratory capacity that many settings lack.

COMPETING DIAGNOSES

Early symptoms overlap with

- Influenza
- COVID-19
- Malaria
- Leptospirosis
- Dengue
- Ebola
- Bacterial sepsis

CLINICAL SUSPICION

Raise suspicion on

- Rodent exposure history
- Occupational risks
- Environmental exposures
- Travel history
- Epidemiological context

LABORATORY CONFIRMATION

Confirm with

- Hantavirus-specific IgM antibodies
- Rising IgG antibody titres
- RT-PCR during acute infection
- Viral sequencing in specialized laboratories

BIOSAFETY

Hantaviruses are high-risk pathogens. Non-inactivated specimens require enhanced biosafety and strict compliance with international transport requirements — a constraint that shapes where testing can realistically be performed.

Management Is Supportive — Timing Determines Survival

With no universally licensed antiviral, early recognition and critical-care readiness are the primary determinants of outcome.

No universally licensed specific antiviral

Management is primarily supportive.

RIBAVIRIN

- Evaluated for HFRS caused by Hantaan virus
- Potential benefit if administered early
- Limited and inconsistent evidence for HCPS

Key supportive interventions

1. **Early recognition and referral:** The single highest-leverage step
2. **Oxygen therapy:** Foundational for HCPS hypoxia
3. **Haemodynamic monitoring:** Detects shock before collapse
4. **Mechanical ventilation:** Where respiratory failure develops
5. **Renal replacement therapy:** For severe HFRS with acute kidney injury
6. **Intensive care management:** For severe HCPS

Prognosis: early intensive supportive care substantially improves survival, particularly for HCPS.

Vaccines: Regional Products, No Global Solution

Inactivated vaccines used for decades in China and the Republic of Korea have no globally licensed or WHO-prequalified equivalent, and the pipeline is constrained by market and biosafety realities.

Current status: no WHO-prequalified or globally licensed hantavirus vaccine is available for widespread international use.

IN USE TODAY

Existing regional vaccines

- Inactivated vaccines against Hantaan and Seoul viruses in China and the Republic of Korea, used for decades
- Targeted at military personnel and other high-risk populations
- Contributed to reduced incidence in endemic regions
- Variable long-term effectiveness and duration of immunity

IN DEVELOPMENT

Research pipeline

- Recombinant protein vaccines
- DNA vaccines
- Viral vector vaccines
- mRNA-based platforms
- Candidates targeting both Old World and New World hantaviruses — none yet broadly approved

WHY IT IS STALLED

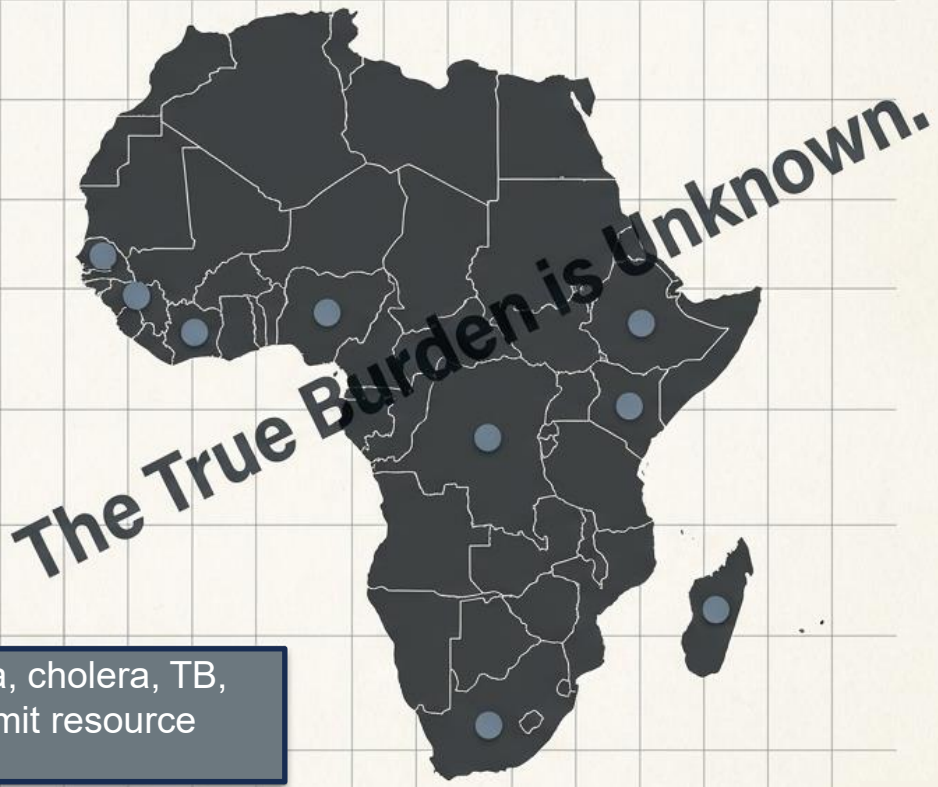
Development challenges

- Geographic diversity of strains
- Limited commercial market incentives
- Sporadic outbreak patterns
- Insufficient clinical trial data
- Biosafety constraints in research settings

The African Surveillance Gap: A Hidden Burden

Hantavirus actively circulates in Africa across diverse mammalian hosts, but weak surveillance and diagnostic limitations mask the true epidemiological burden.

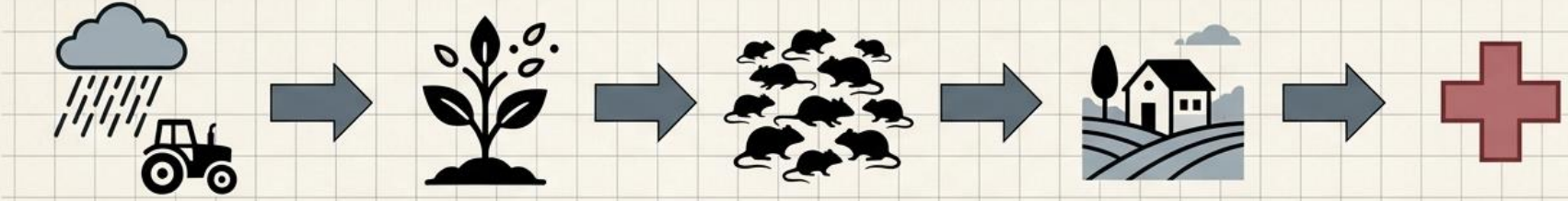
1. **The Data Void:** Burden is fragmented, substantially underestimated, and true prevalence is unknown.
2. **Serological Footprint:** Documented across Côte d'Ivoire, Guinea, Senegal, Nigeria, DRC, Ethiopia, Kenya, Madagascar, South Africa.
3. **Viral Discoveries & Hosts:** e.g., Sangassou virus identified in Guinea. African hantaviruses identified not just in rodents, but broadly in shrews and bats.



Competing priorities: High burdens of malaria, cholera, TB, HIV/AIDS, recurrent viral hemorrhagic fevers limit resource allocation

The Catalyst: Climate and Land-Use Drivers

Climate variability and aggressive land-use changes force rodents, shrews, and bats into dense human habitats, accelerating spillover risk.



Climate & Land-Use: El Niño patterns (heavy rains, mild winters) and deforestation/mining.

Ecological Shift: "Mast years" trigger massive seed crop booms and habitat destruction.

Population Surge: Exponential rodent population growth.

The Ecological Interface: Vectors forced into farms, peri-urban zones, and water sources.

Spillover: Outbreak occurs. (Identical ecological dynamics namics drive recurring Lassa fever outbreaks).

Precedent: Similar ecological dynamics have already been observed with Lassa fever in Nigeria and Guinea — a rodent-borne haemorrhagic fever whose emergence pattern gives us a working template for how a pathogenic African hantavirus would likely announce itself.

What Needs to Happen Next

1. Virological and ecological studies of wildlife reservoirs
2. Human surveillance in endemic regions with specialized diagnostic tools
3. **Sampling strategy:** Rodent samples from disturbed habitats where humans experience unexplained febrile illness
4. Genetic sequencing and data-sharing partnerships to integrate animal, environmental, and human signals
5. **Spillover identification:** Determine where, how, and under which environmental conditions spillover occurs before outbreaks emerge

Goal: Strengthen surveillance to identify high-risk interfaces, emerging transmission zones, and spillover drivers to anticipate pathogenic African hantaviruses