

PRESENTATION

# The Virus in the Dust

An ecology, climate, behavior, and surveillance  
story about hantavirus.

**“Hantavirus is not just a virus story.  
It is an ecology, climate,  
behavior, and surveillance story.”**

**≈ 200,000**

estimated global hantavirus infections per year

**0**

FDA-approved antivirals or vaccines

**35 - 50%**

case-fatality for hantavirus pulmonary syndrome

## Two syndromes, one virus family

Hantaviruses split along an Old-World / New-World fault line. Reservoirs and target organs differ.

### HFRS — Hemorrhagic Fever with Renal Syndrome

Old World hantaviruses

*Target organ: kidneys (acute renal injury, capillary leak)*

#### Hantaan virus (HTNV)

**CFR 5-15%**

Host: Striped field mouse (*Apodemus agrarius*)

Region: Asia

#### Seoul virus (SEOV)

**CFR 1-5%**

Host: Norway rat (*Rattus norvegicus*)

Region: Worldwide / urban

#### Puumala virus (PUUV)

**CFR <1%**

Host: Bank vole (*Myodes glareolus*)

Region: Northern Europe / NE

#### Dobrava-Belgrade (DOBV)

**CFR 10-15%**

Host: Yellow-necked mouse (*A. flavicollis*)

Region: Balkans

### HPS / HCPS — Hantavirus (Cardio)Pulmonary Syndrome

New World hantaviruses

*Target organ: lungs (non-cardiogenic pulmonary edema)*

#### Sin Nombre virus (SNV)

**CFR ~35-40%**

Host: Deer mouse (*Peromyscus maniculatus*)

Region: U.S. / Canada

#### Andes virus (ANDV)

**CFR up to 50%**

Host: Long-tailed pygmy rice rat

Region: Argentina / Chile

#### Choclo virus

**CFR ≈10-15%**

Host: *Oligoryzomys* spp.

Region: Panama / C. America

#### Bayou / Black Creek Canal

**CFR 30-50%**

Host: Cotton rat / rice rat

Region: U.S. SE / Gulf

Sources: Afzal et al. 2023 (*Front Microbiol*, 10.3389/fmicb.2023.1233433); CDC Hantavirus 2024; WHO Hantavirus fact sheet.

## Hantavirus around the world — two syndromes, many reservoirs

HPS dominates the Americas; HFRS dominates Eurasia. Novel orthohantaviruses continue to be discovered in shrews, moles, and bats.



Sources: CDC 2024 · WHO Hantavirus fact sheet · Afzal et al. 2023 · PLOS NTD 2026 (SE Asia meta-analysis).



## From rodent ecology to a single breath of dust

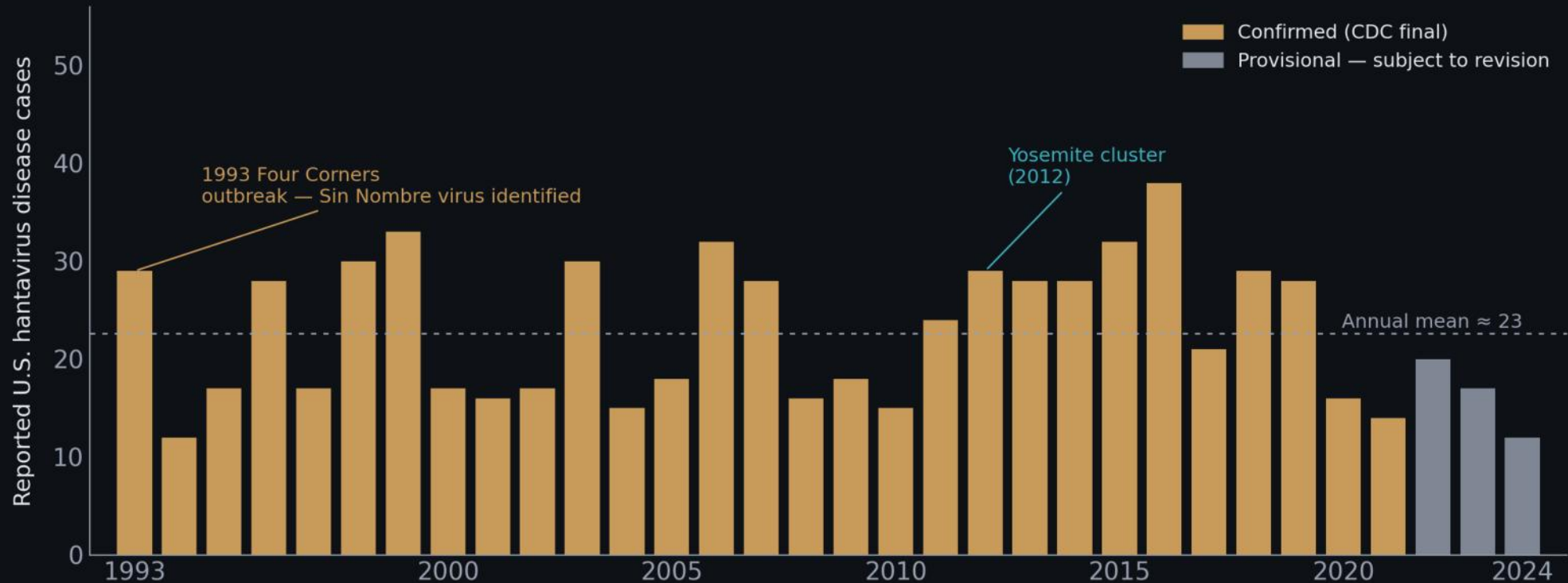
Most exposure happens indoors, where dried rodent excreta become aerosolised by sweeping, vacuuming, or ventilation gusts.



*Mechanism informed by CDC 2024; Wells et al. 1997; Hardestam et al. 2007 (env. persistence); Martinez et al. 2005 (ANDV person-to-person).*

## U.S. hantavirus disease — annual case counts, 1993-2024

859 HPS cases + 31 non-pulmonary cases reported through 2023; ≈35% case-fatality rate; 94% west of the Mississippi.



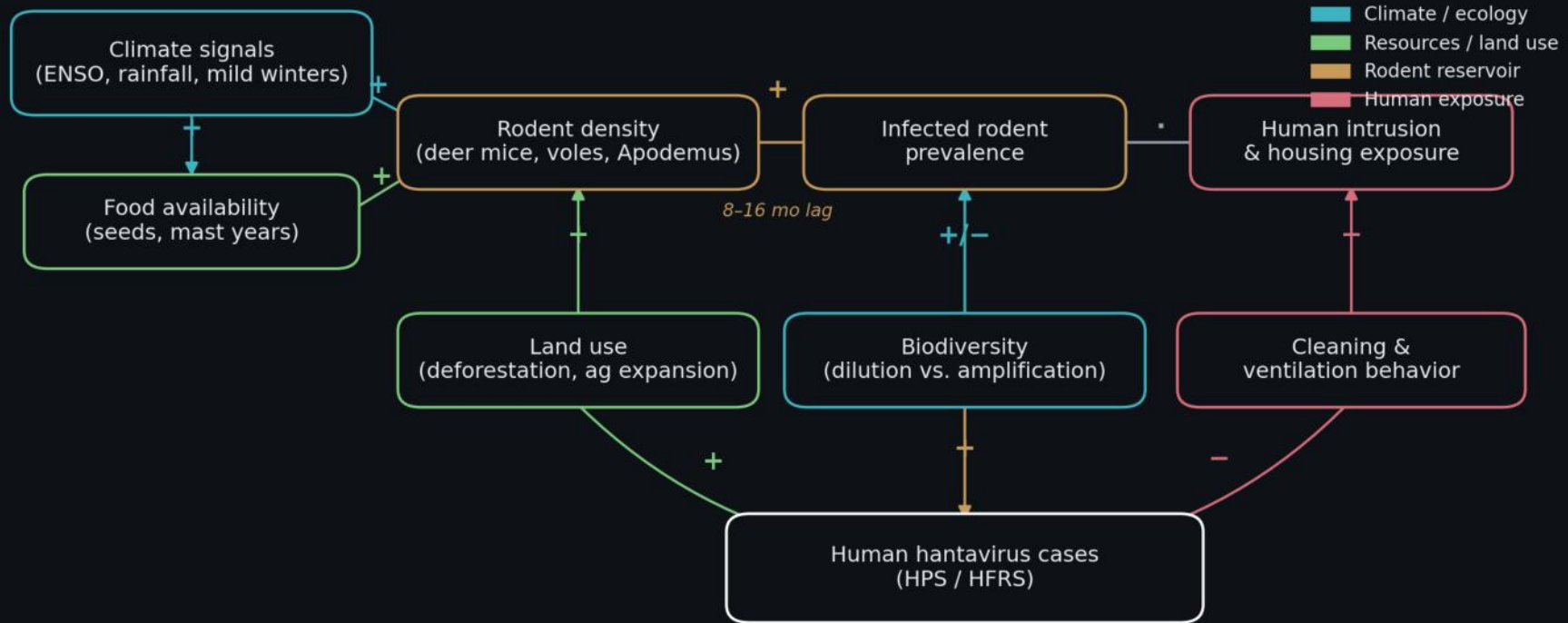
Source: CDC, Reported Cases of Hantavirus Disease ([cdc.gov/hantavirus](https://cdc.gov/hantavirus)). Refresh from NNDSS before publication.

**DATA CAVEAT:** Recent years are PROVISIONAL — counts revise upward as states reconcile with CDC. Refresh from the NNDSS dashboard before publication.

→ [cdc.gov/hantavirus/data-research/cases](https://cdc.gov/hantavirus/data-research/cases) · [data.cdc.gov](https://data.cdc.gov) · CDC WONDER (MMWR)

## Why outbreaks happen — a systems view

Climate, food, rodents, behavior, and built environment combine to make a viral year.



+ : positive driver · - : protective effect · +/- : context-dependent (dilution effect can run both ways).  
 Synthesis based on Yates 2002; Luis et al. 2018 (PNAS); Tian et al. 2022; PMC 11338209 (land-use review).

## Where exposure happens — five high-risk settings compared

Risk emerges where rodent activity meets enclosed air and disruptive cleaning.

	Rodent presence	Dust generation	Enclosed air	Cleaning shock
<b>Closed cabin (rustic, seasonal)</b> <i>Yosemite-type tent cabins, remote rentals · Yosemite 2012: 10 cases linked to insulated tent cabins.</i>	5	5	5	5
<b>Working farm &amp; outbuildings</b> <i>Grain bins, barns, shelter belts · Old World HFRS strongly tied to agricultural workers.</i>	4	4	5	4
<b>Field biology &amp; ecology fieldwork</b> <i>Rodent trapping, remote stations · PPE &amp; training reduce, but do not eliminate, risk.</i>	3	3	4	3
<b>Garden shed &amp; garage</b> <i>Spring clean-out, long-stored boxes · The classic 'opened the shed in April' exposure.</i>	4	4	5	5
<b>Disturbed habitat (post-fire, demolition)</b> <i>Flooding, construction, rodent displacement · Climate-driven displacement increasingly relevant.</i>	3	5	4	4

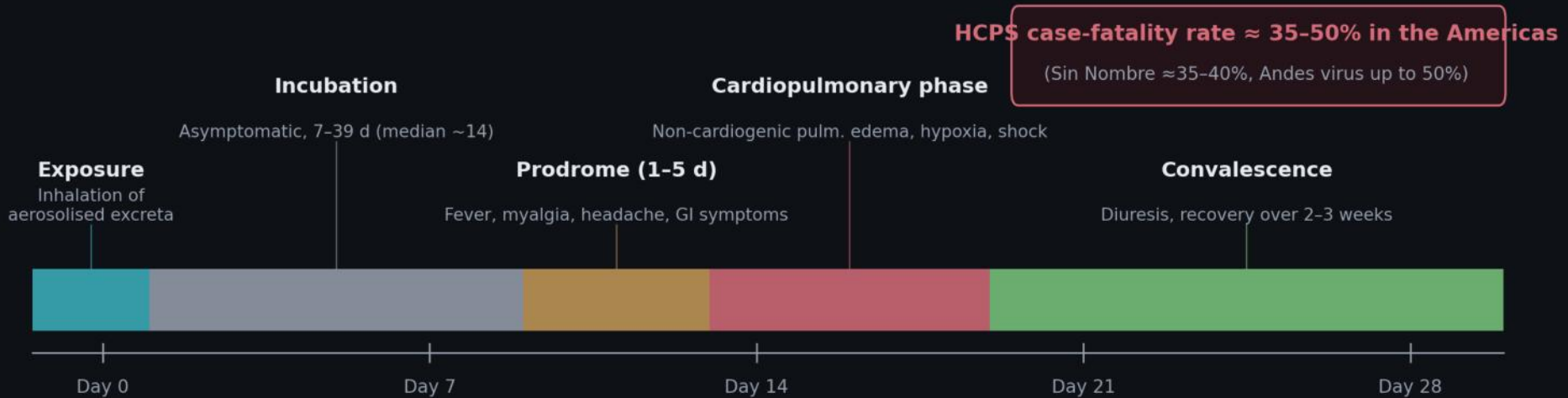
Dot size & shade encode relative risk (1-5). Magenta = highest, amber = high, teal = moderate.

Sources: CDC MMWR 2012 (Yosemite cluster); CDC Hantavirus Prevention 2024; OSHA Hantavirus Overview; Vaheri et al. 2013 (HFRS occupational exposure).



## Clinical course of hantavirus pulmonary syndrome

Care is largely supportive; the window from prodrome to severe pulmonary edema can be hours.



### Recognise & admit early

ICU triage when prodrome overlaps with respiratory failure

### Supportive care

Mechanical ventilation, vasopressors, careful fluids

### ECMO if refractory

VV-ECMO survival 45-65% (vs ≈50% mortality severe HPCS)

### Antivirals?

Ribavirin: inconclusive (Mertz 2004); none approved

Sources: CDC 2024; WHO Hantavirus fact sheet; Mertz et al. 2004 (ribavirin trial); Dietl et al. 2008 (ECMO case series); StatPearls HPS 2024.

## Prevention: three steps that matter

If you must enter a closed, dusty, rodent-occupied space — do these in order.

### BEFORE ANY CLEANING:

seal cracks  $\geq \frac{1}{4}$ " · store food in metal/glass · trim brush from walls · trap, don't tolerate

## 01

### Air it out — 30 minutes

Open every door & window before you set foot inside. Let the wind do the work.

## 02

### Wet-clean with 1:10 bleach

Spray droppings, urine, nests until soaked. Wipe with paper towels; bag and seal.

## 03

### PPE — N95, gloves, goggles

NIOSH-approved respirator, rubber/nitrile gloves, eye protection. Coveralls if heavy contam.

### DON'T:

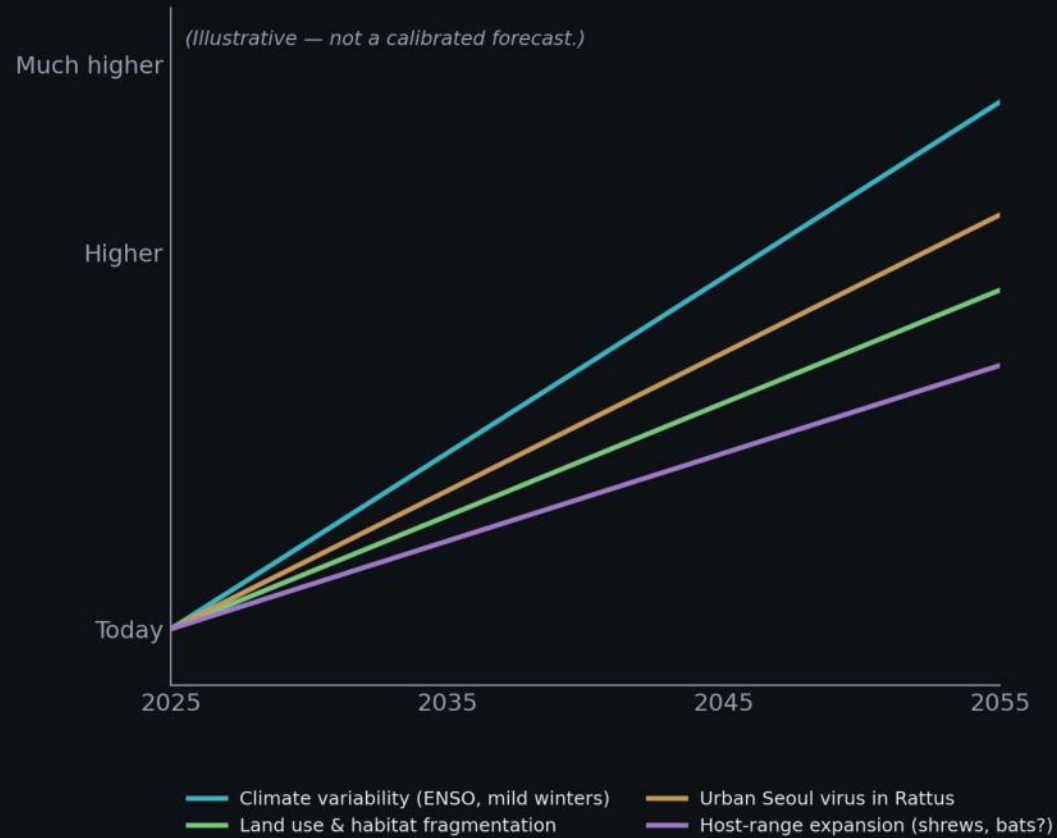
sweep · vacuum · use a leaf blower · shake out bedding · skip the wait · skip the mask

Source: CDC Hantavirus Prevention guidelines; OSHA Hantavirus Overview; CDC MMWR 2012 (Yosemite outbreak response).

## Future risk — climate, land use, and ecological change

Hantavirus risk doesn't require a new virus. It mostly requires a new world for the rodents we already have.

Qualitative trajectories of hantavirus risk drivers



### Tropical Latin America

Choclo (Panama), Juquitiba (Brazil), Laguna Negra (Paraguay) outbreaks tied to rainfall.

### Urban Seoul virus

Norway-rat-borne SEOV detected on every inhabited continent; cases rising in cities.

### Africa & Asia, novel hosts

Sangassou, Nova, Lena viruses found in shrews, moles, bats — reservoir status unclear.

### Disturbed-habitat events

Floods, wildfires, demolition push rodents into homes — a climate-amplified pathway.

Sources: Tian et al. 2022; Afzal et al. 2023; PMC 11338209 (land-use review); PMC 12017062 (host-range review); PLOS NTD 2026 (SE Asia rodent meta-analysis).

## Three surprises. Three open questions.

Pulling the thread of hantavirus opens questions that climate, ecology, and surveillance still haven't answered.

### SURPRISES

#### **Andes virus is the only New-World hantavirus with documented human-to-human transmission.**

Documented in Argentina and Chile during the prodromal phase — household and ICU clusters.

— *Martinez et al. 2005*

#### **Deer-mouse hantavirus prevalence lags rodent density by 8-16 months.**

A wet year sets up a viral year — but not the same year. Surveillance must look 1-2 years ahead.

— *Yates et al. 2002*

#### **Hantaviruses survive in dried excreta for days under cool, dark conditions.**

Why sweeping a long-empty cabin is a real exposure. Humidity, UV, and temperature break them down.

— *Hardestam et al. 2007*

### OPEN QUESTIONS

#### **Can a single pan-hantavirus vaccine work?**

HTNV-only vaccines exist in China; mAbs and DNA candidates are advancing — but no global option.

#### **Are bats and shrews real reservoirs, or incidental hosts?**

Sequence-positive, but spillover capability is unclear. The answer reshapes 'rodent-borne' framing.

#### **Can climate models forecast outbreaks 12-24 months in advance?**

Lagged ecology suggests yes, in principle. The data streams to do it cheaply and globally don't yet exist.

*Synthesised from the cited literature; positions framed as hypotheses where evidence is mixed.*



ONE TAKEAWAY

# Watch the rodents. Watch the rain. Watch the dust.

Hantavirus is most preventable when ecology, climate, and behavior are read together — and when we update our surveillance, not just our slides.