

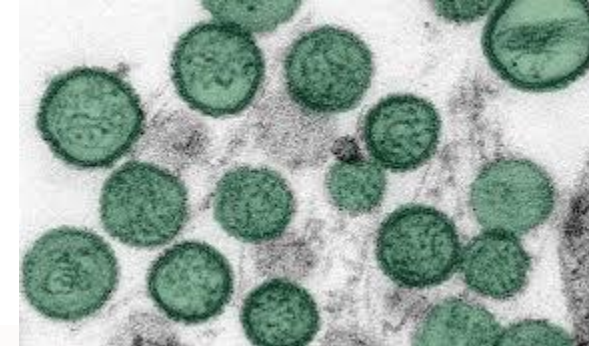


Hantavirus

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MV *Hondius* hantavirus outbreak



MV *Hondius* at the port of Granadilla on 10 May 2026, where the passengers departed the ship for quarantine.

| | |
|------------------------|--|
| Disease | Hantavirus pulmonary syndrome |
| Pathogen | Andes virus |
| Date | 1 April 2026 – 11 May 2026 ^{[1][2]} <i>[clarification needed]</i> |
| Confirmed cases | 11 ^{[3][4][a]} |
| Suspected cases | 2 ^{[4][a]} |
| Deaths | 3 ^{[4][a]} |

Differential Diagnosis of Hantavirus Infection

Consider these conditions with overlapping clinical features

1



Influenza

2



COVID-19

3



Viral pneumonia

4



Leptospirosis

5



Dengue

6



Sepsis

Careful Patient History is Essential



Rodent exposure



Occupation / Environment



Travel history



Contact with known cases

Classification of Hantavirus

| Classification | Nomenclature |
|-----------------|---|
| Kingdom | Virus |
| Class | Elliviricetes |
| Family | Bunyaviridae |
| Sub-Family | Hantaviridae |
| Genus | Orthohantavirus |
| Species | Hantavirus |
| Vernacular name | Old World virus (Hokkaido virus Hokv, Muju Virus Mju); New World virus (Sin Nombre virus SNV, Andes virus ANDV) |

Source: Leighton *et al.*, 2003.



RODENT RESERVOIR

Natural infection in rodents
(persistent, lifelong)
No apparent illness



Urine



Feces



Saliva

Continuous viral shedding
in excreta



Human infection

Mainly through inhalation
of aerosolized particles
from contaminated excreta

EUROPE & ASIA

HFRS

(Haemorrhagic Fever with Renal Syndrome)



- Fever
- Hemorrhage
- Renal involvement
- Variable severity

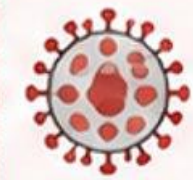
NORTH, CENTRAL & SOUTH AMERICA

HPS / HCPS

(Hantavirus Pulmonary Syndrome)



- Fever
- Severe pulmonary involvement
- Respiratory failure
- High case fatality rate



Andes virus

Limited human-to-human transmission among close and prolonged contacts (Argentina and Chile)

BURDEN OF DISEASE



Worldwide, an estimated
10,000–100,000+
hantavirus infections occur
each year.

CASE FATALITY RATE (CFR)

Asia
and Europe
<1–15%



Americas
up to **50%**



Hantavirus infections are relatively uncommon globally but can be severe.

THE AMERICAS



HCPS
(Hantavirus
Cardiopulmonary
Syndrome)

- **Much rarer:** hundreds of cases reported each year across the continent
- **USA:** <1,000 cases
- **South America** (Argentina, Brazil, Chile, Paraguay): small numbers of cases annually



High CFR:

20%–40%

(up to 50% in some settings)

EAST ASIA



HFRS
(Hemorrhagic Fever
with Renal Syndrome)

Many thousands of cases annually, especially in China and the Republic of Korea.

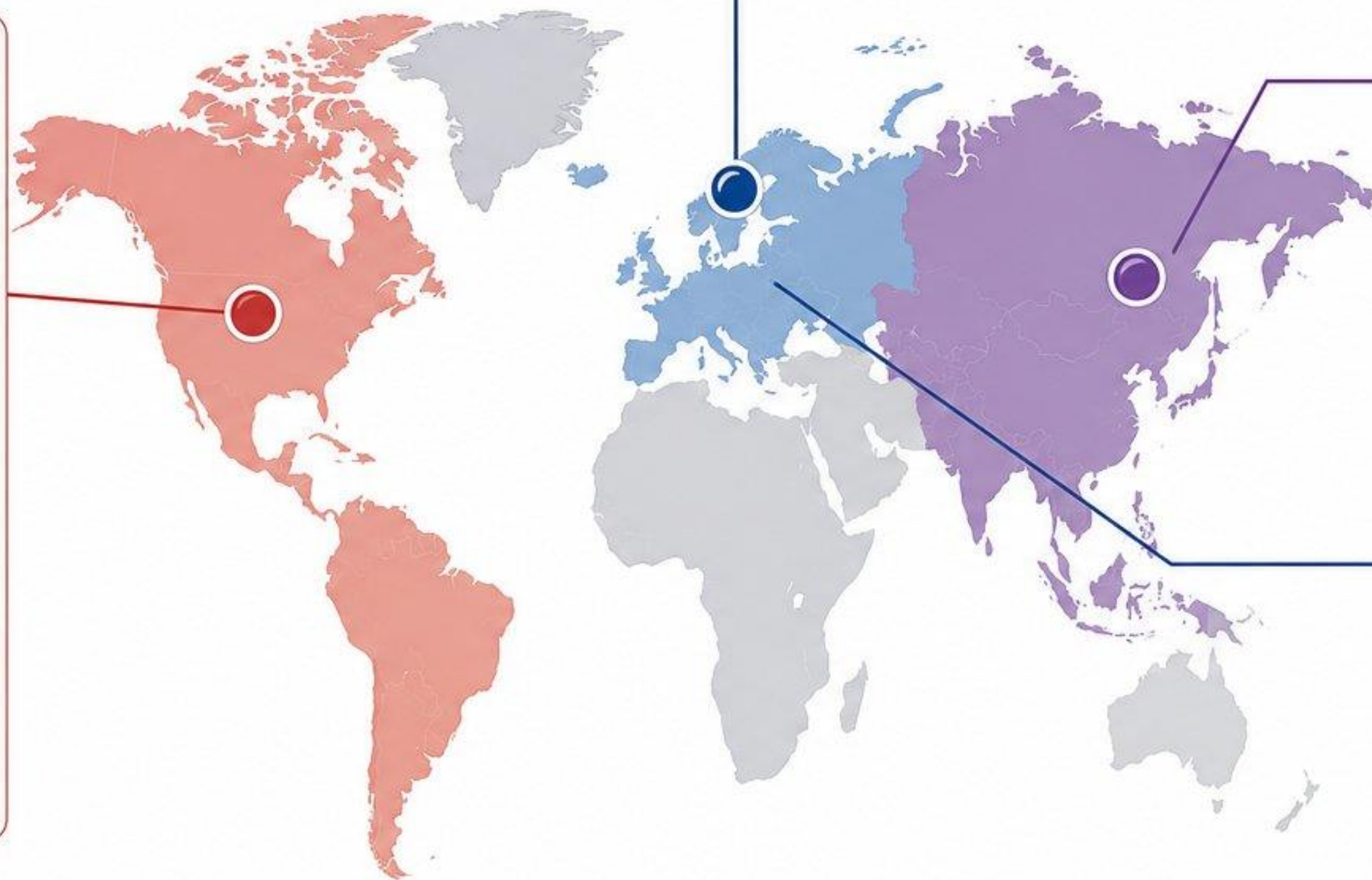
Incidence has declined in recent decades.

EUROPE



HFRS
(Hemorrhagic Fever
with Renal Syndrome)

- Several thousand cases reported each year
- Mainly in northern and central regions where Puumala virus circulates.

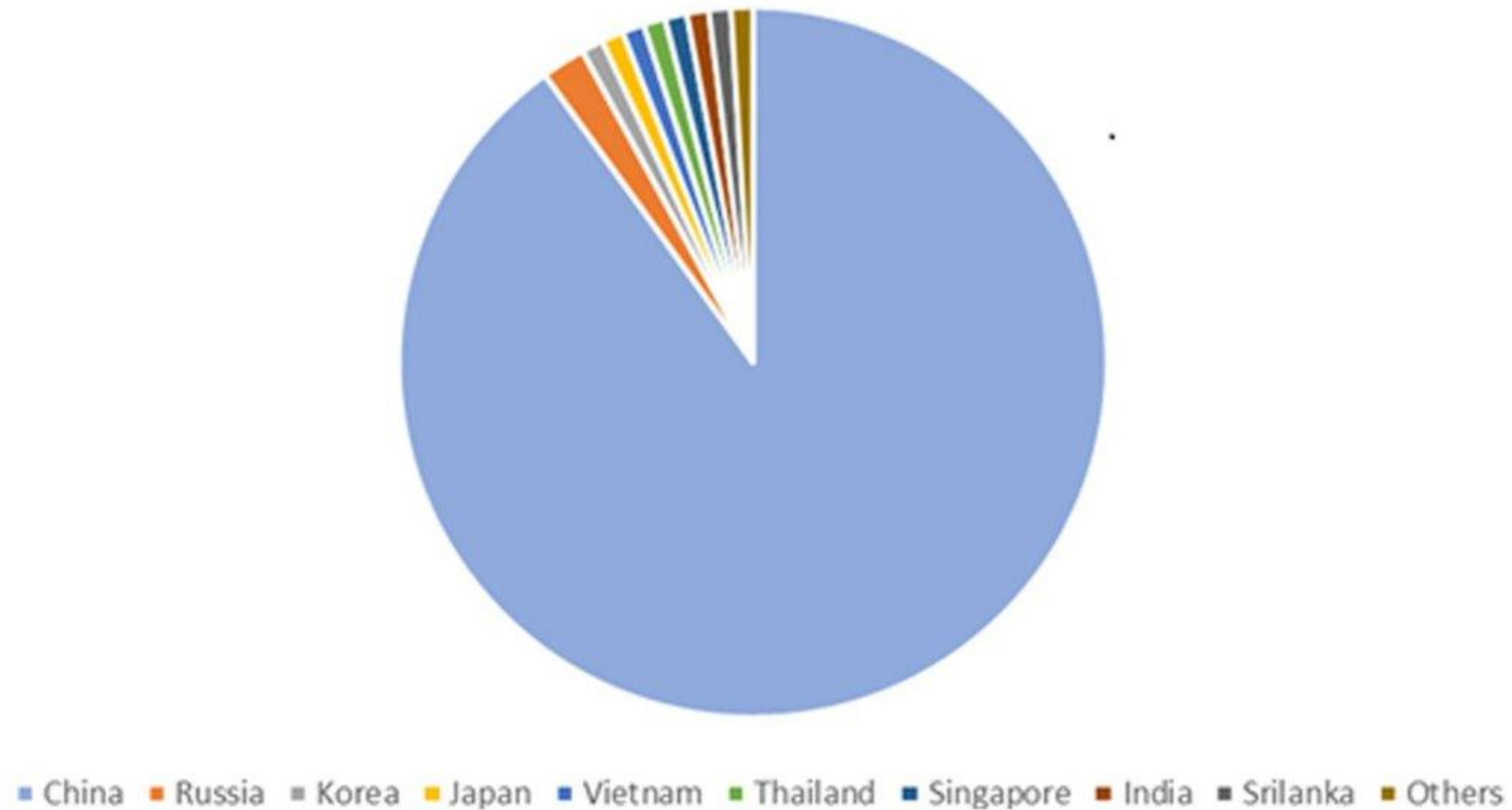


Human diseases caused by hantaviruses

| Disease | Affected Organs | Etiological Viruses * | Case Fatality Rate | Distribution |
|---|---|-----------------------|--------------------|--------------------------------------|
| Hemorrhagic fever with renal syndrome (HFRS) | Kidney, spleen, liver, brain, blood vessels, eyes | HTNV | ~1% | China, South Korea, Russia, Vietnam |
| | | SEOV | <1% | Worldwide |
| | | DOBV | 0–15% | Europe |
| | | TULV | ~0% | Eurasia |
| | | PUUV | 0.1–0.4% | Europe |
| Hantavirus cardiopulmonary syndrome or hantavirus pulmonary syndrome (HCPS/HPS) | Lung, heart, spleen, liver, blood vessels | ANDV | ~40% | Argentina, Chile |
| | | SNV | 30–50% | USA, Canada |
| | | CHOV | 12–15% | Panama |
| | | LNV | 12–15% | Argentina, Brazil, Paraguay, Bolivia |

*: HTNV: Hantaan virus; SEOV: Seoul virus; DOBV: Dobrava-Belgrade virus; TULV: Tula virus; PUUV: Puumala virus; ANDV: Andes virus; SNV: Sin Nombre virus; CHOV: Choclo virus; LNV: Laguna Negra virus.

Epidemiology of Hantavirus cases across Asia, showing 90% infections in China, 2% in Russia and 1% in Korea, Japan, Vietnam, Thailand, Singapore, India, Srilanka, Others.

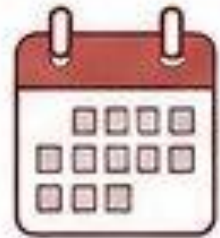


HANTAVIRUSES

HEMORRHAGIC FEVER WITH RENAL SYNDROME (HFRS)

HFRS is caused by Old World hantaviruses and is characterized by fever, thrombocytopenia, and acute renal insufficiency.

1. INCUBATION PERIOD



Typically around **2 weeks**
(range: 5–42 days)



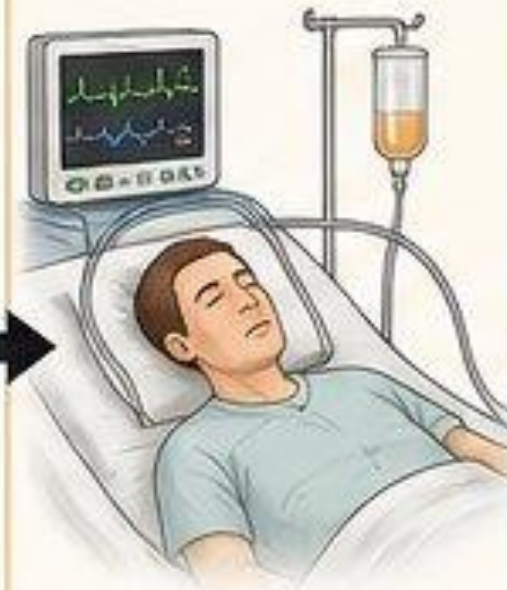
2. CLINICAL STAGES (Severe HFRS)

1. FEBRILE (TOXIC) STAGE (3–7 days)

- Fever, chills
- Headache
- Abdominal & lower back pain
- Dizziness
- Blurred vision
- Conjunctival injection
- Petechiae over upper trunk and soft palate
- Erythematous flush (blanches on pressure)
- Leukocytosis (often $>20,000/\text{mm}^3$)
- Left shift, atypical lymphocytes
- Thrombocytopenia

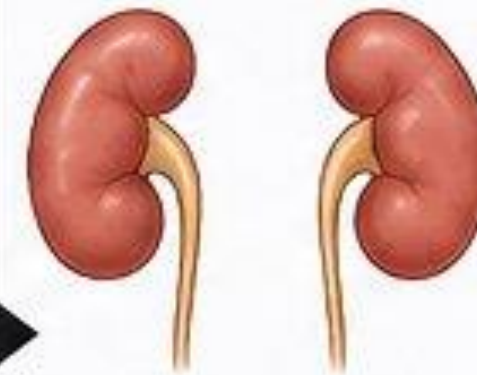
Many patients experience severe clinical shock at the end of this stage.

2. HYPOTENSIVE STAGE (Hours–1 day)



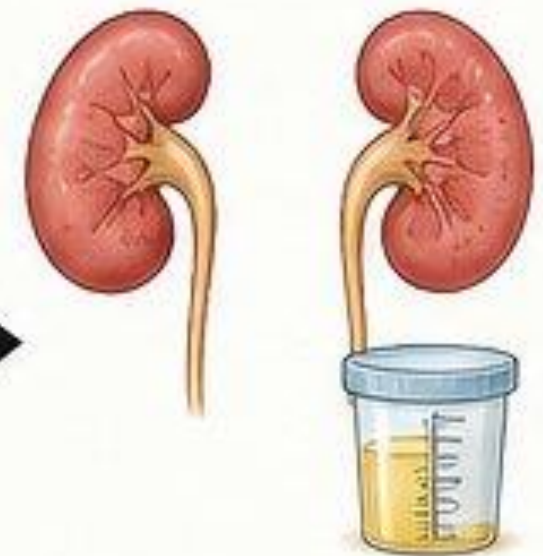
- Hypotension, shock
- Capillary leak
- Hemorrhagic tendencies

3. OLIGURIC STAGE (3–10 days)



- Oliguria / Anuria
- Acute renal insufficiency
- Mucosal bleeding diathesis
- Electrolyte & acid-base abnormalities
- Hypertension
- Pneumonitis, pulmonary edema

4. POLYURIC STAGE (Days–weeks)



- Polyuria (high urine output)
- Risk of dehydration
- Fluid & electrolyte imbalance
- Gradual recovery

LABORATORY FEATURES (Severe HFRS)



Thrombocytopenia



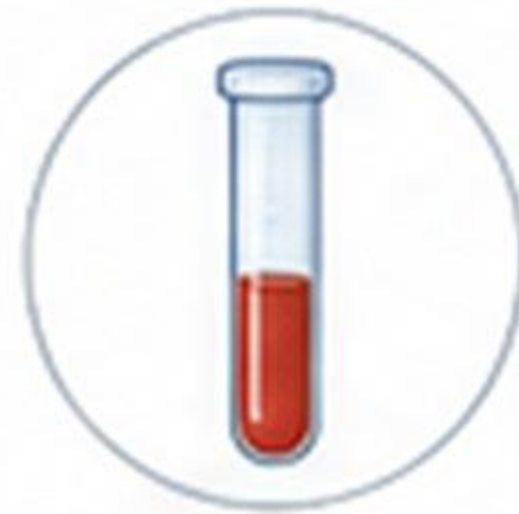
Leukocytosis
(often $>20,000/\text{mm}^3$)
with left shift



Proteinuria
Hematuria



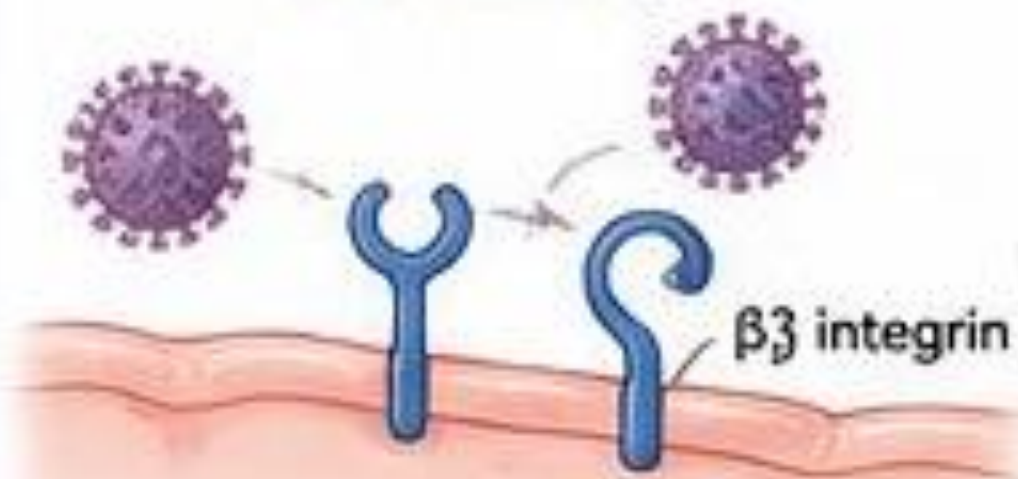
Elevated serum
creatinine,
BUN



Electrolyte &
acid-base
abnormalities

PATHOGENESIS OF HANTAVIRUS DISEASE

1. Viral Entry



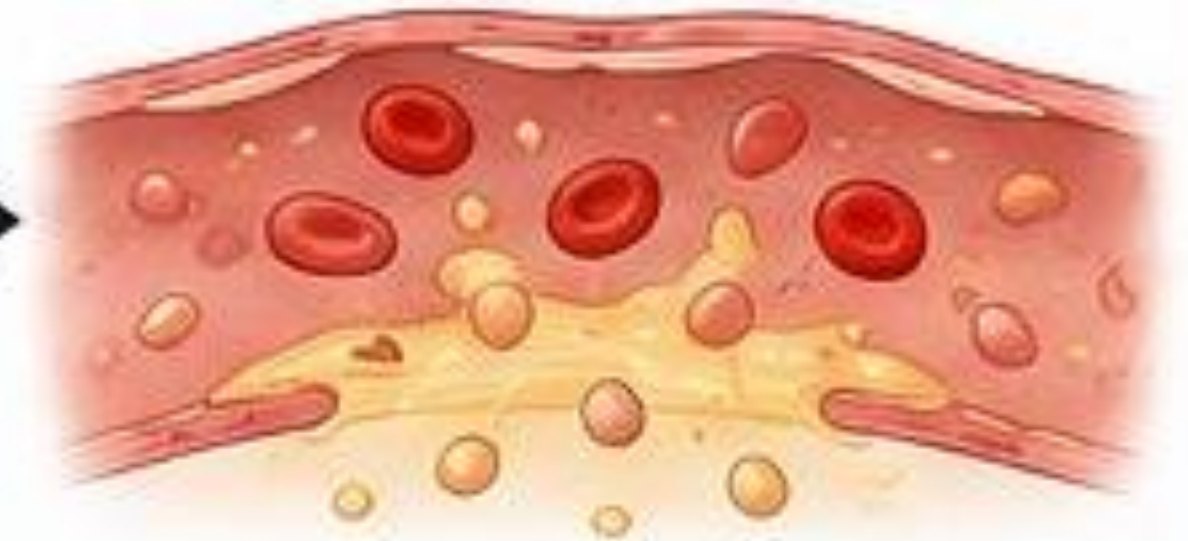
Hantaviruses enter endothelial cells via β_3 integrins.

2. Endothelial Dysfunction



Disruption of cell-to-cell adhesion and increased vascular permeability (capillary leak).

3. Capillary Leak Syndrome



Leads to hemodynamic changes and diverse clinical manifestations.

HEMORRHAGIC FEVER WITH RENAL SYNDROME (HFRS)

Immune & Inflammatory Mechanisms



↑ Bradykinin



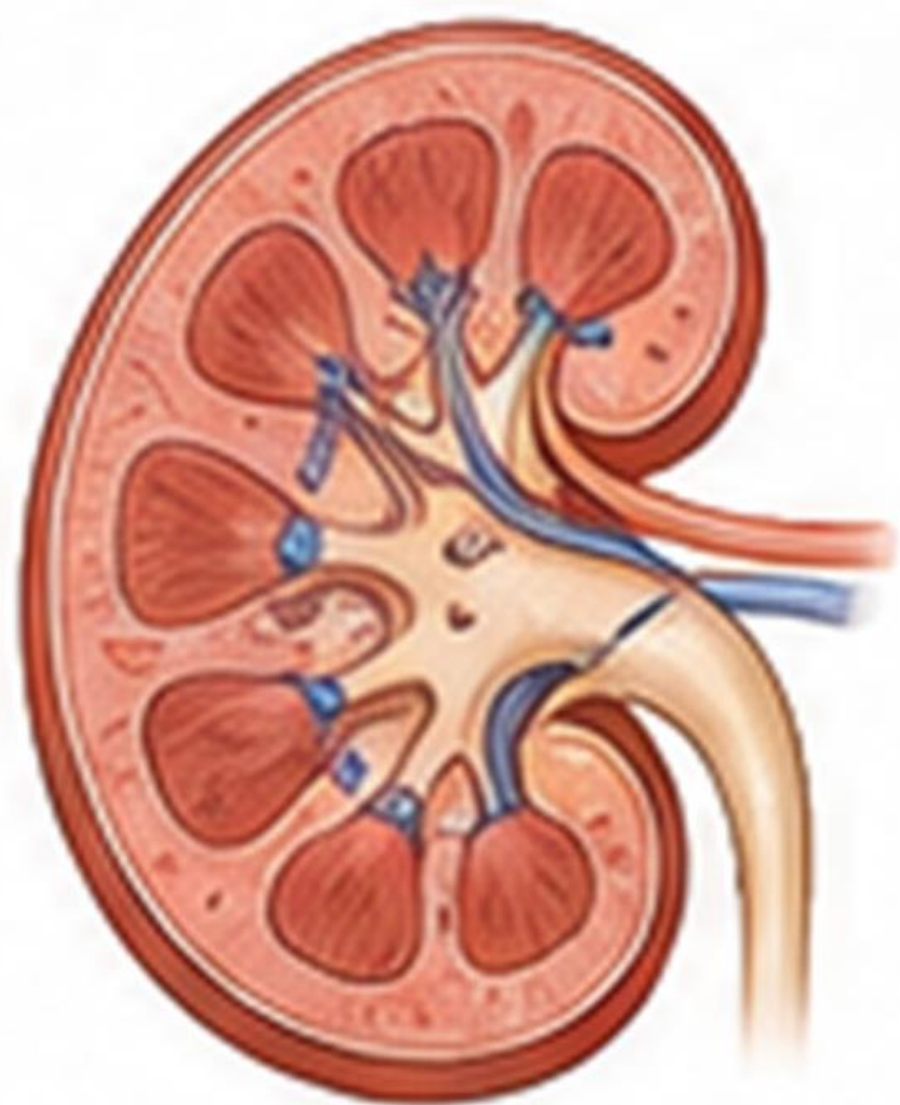
↑ Cytokines
(IL-6, TNF- α , etc.)



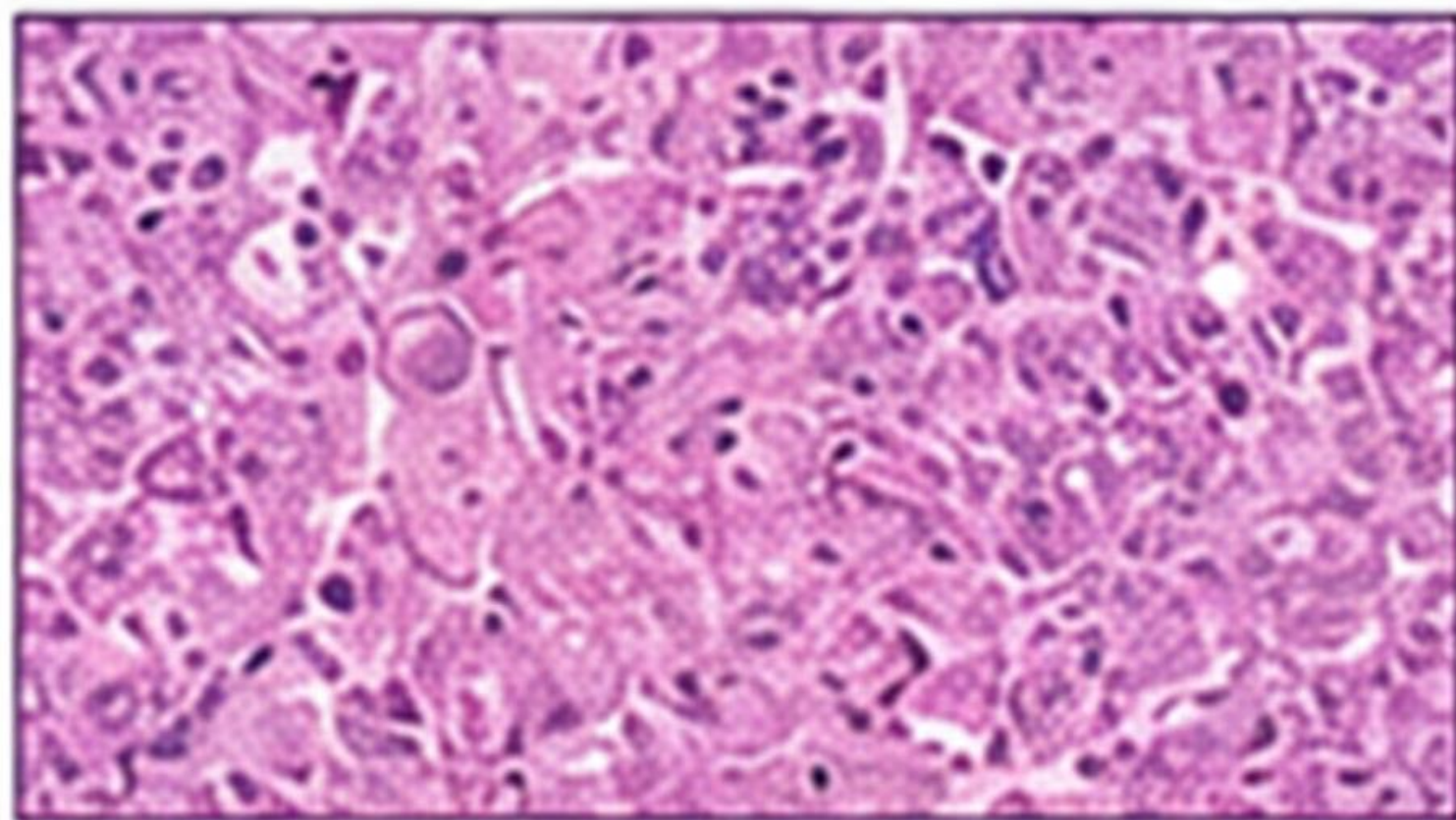
Complement
Activation

- Both classical and alternative pathways activated
- Complement components C3 and C5 are linked to coagulation & fibrinolysis disorders

HEMORRHAGIC FEVER WITH RENAL SYNDROME (HFRS)



Renal Pathology



- Predominantly affects medullary tubules
- Due to systemic & intrarenal hemodynamic factors and immune-mediated injury (kinins, cytokines)

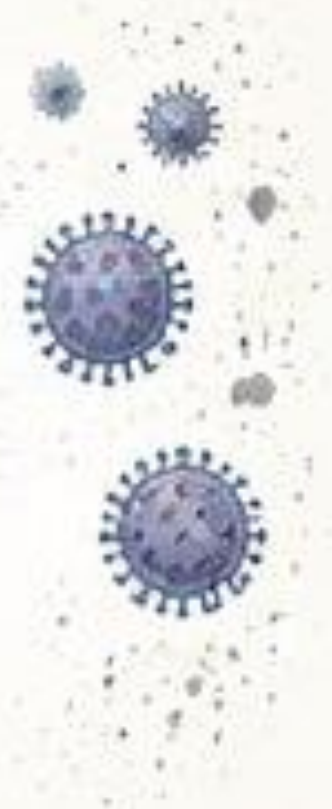
HANTAVIRUS

PULMONARY SYNDROME (HPS)

HPS is a rare but severe disease caused by hantaviruses and is characterized by rapid-onset pulmonary edema due to increased pulmonary vascular permeability.

CAUSE & TRANSMISSION

Hantaviruses are carried by rodents. Humans are infected primarily through inhalation of aerosolized virus from rodent urine, droppings, or saliva.



CLINICAL STAGES OF HPS

1 PRODROMAL STAGE (3–7 days)

- Sudden-onset fever
- Generalized myalgia
- Headache
- Abdominal pain
- GI disturbances (nausea, vomiting, diarrhea)



2 CARDIOPULMONARY STAGE (1–10 days after prodrome)

- Cough, dyspnea
- Fever, tachycardia, tachypnea
- Mild hypotension
- Progression to hypoxia, interstitial pulmonary edema
- May progress to shock and severe pulmonary edema



3 DIURETIC STAGE (Hours to days)

- Hemodynamic stability returns
- Diuresis
- Improvement in oxygenation
- Vascular leak resolves



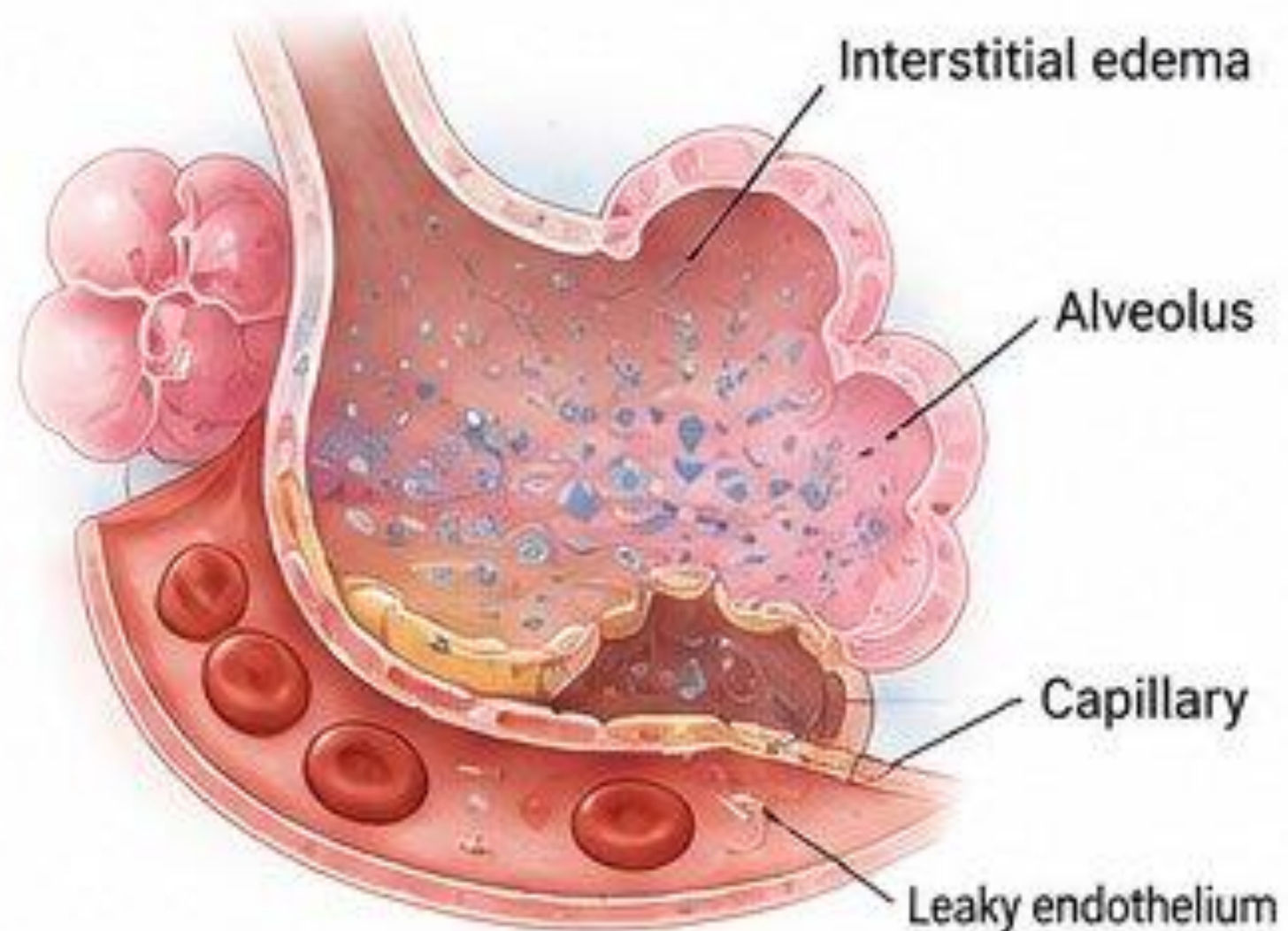
4 CONVALESCENT STAGE (Days to weeks)

- Gradual recovery
- Fatigue may persist for weeks to months
- Most patients have complete recovery



PATHOPHYSIOLOGY

Hantavirus infects endothelial cells and causes immune-mediated damage leading to increased pulmonary vascular permeability.



Result: Noncardiogenic pulmonary edema, hypoxemia, and potentially fatal respiratory failure.

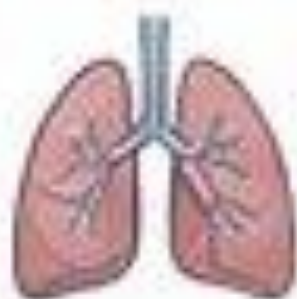
CLINICAL & LABORATORY FEATURES



Fever



Tachycardia



Tachypnea



Mild hypotension

Common Laboratory Abnormalities



- Elevated hematocrit



- Leukocytosis with left shift



- Atypical lymphocytes and immature myeloid cells on smear



- Mild thrombocytopenia



- Mild ↑ serum creatinine, proteinuria (in some cases)

Severe renal involvement (as in HFRS) is not typical.

HISTOPATHOLOGY (LUNG)

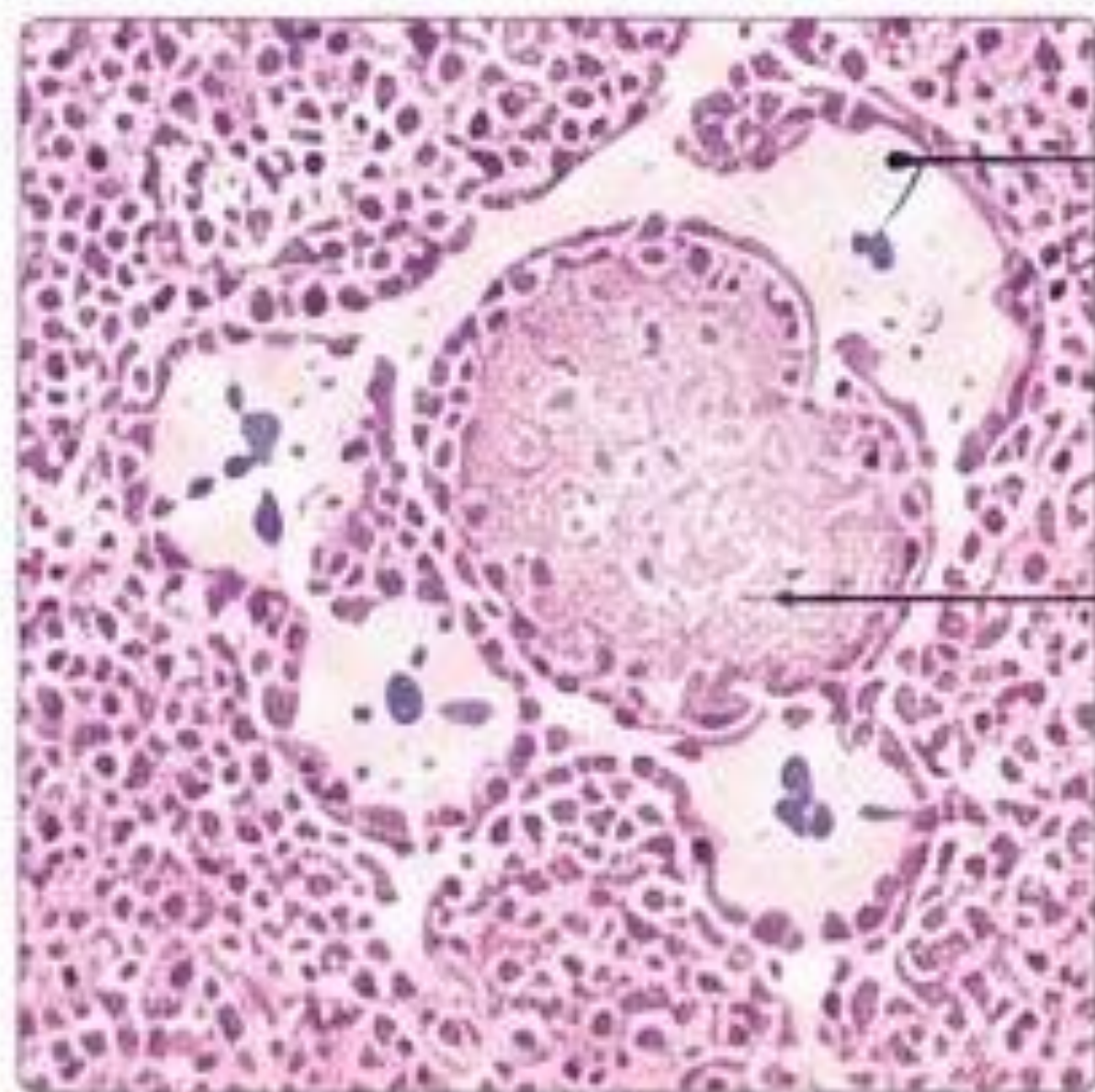
- Interstitial infiltrates of T lymphocytes



- Alveolar pulmonary edema



- Minimal necrosis
- No marked polymorphonuclear leukocyte involvement



Interstitial lymphocytes

Pulmonary edema in alveolar spaces

These changes cause direct damage to respiratory epithelium and marked vascular permeability.

DIAGNOSIS – 5-POINT SCREEN

(Early in Disease Course)

- ✓ Thrombocytopenia
- ✓ Elevated hemoglobin/hematocrit
- ✓ Granulocytic left shift
- ✓ High percentage of immunoblasts (atypical lymphocytes)
- ✓ Lack of toxic changes in neutrophils

Sensitivity: 89%
Specificity: 93%
(in endemic settings)

Useful for rapid identification of presumptive cases before serology results.



WHEN TO SUSPECT HPS

In an otherwise healthy adult with epidemiologic risk factors or living in an endemic area who develops:

- Unexplained pulmonary edema
- Suspected adult respiratory distress syndrome (ARDS) without another known cause

Risk factors / Exposure

- Living in or travel to endemic areas
- Exposure to rodent urine, droppings, or saliva (e.g., cleaning enclosed spaces)
- Outdoor or occupational exposures

MANAGEMENT



Early oxygen support



Hemodynamic monitoring & support



ECMO for refractory cases

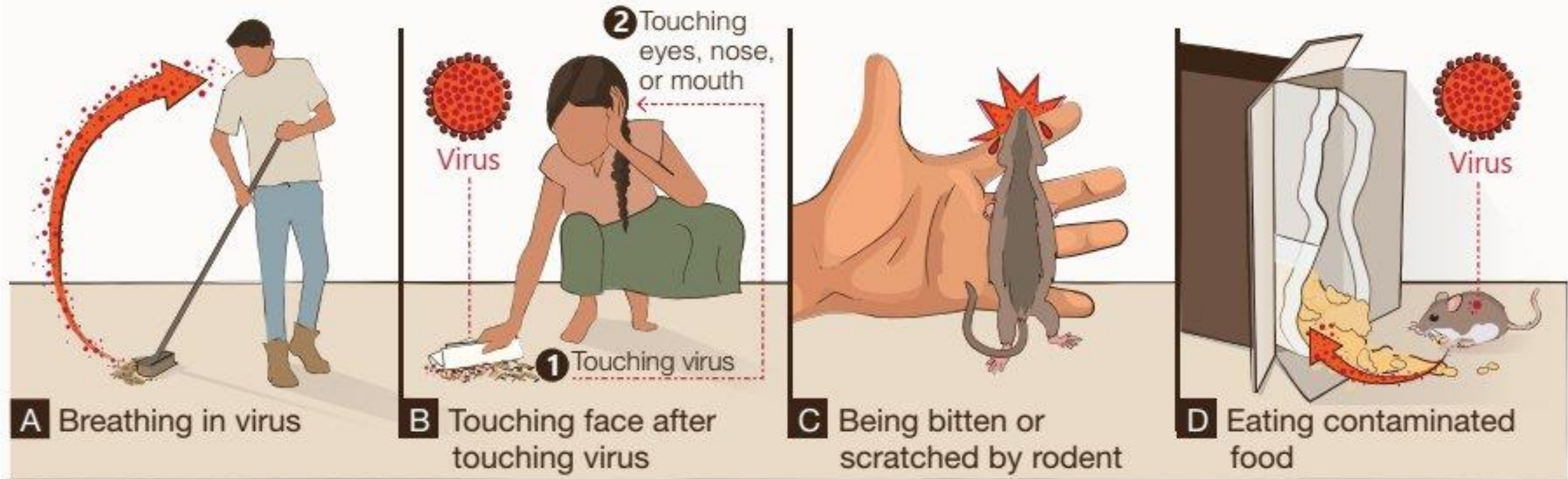


Supportive care

With appropriate supportive care, most patients recover fully.
ECMO has been associated with improved survival in severe cases.

How do people get HPS?

TRANSMISSION: A person can be infected by



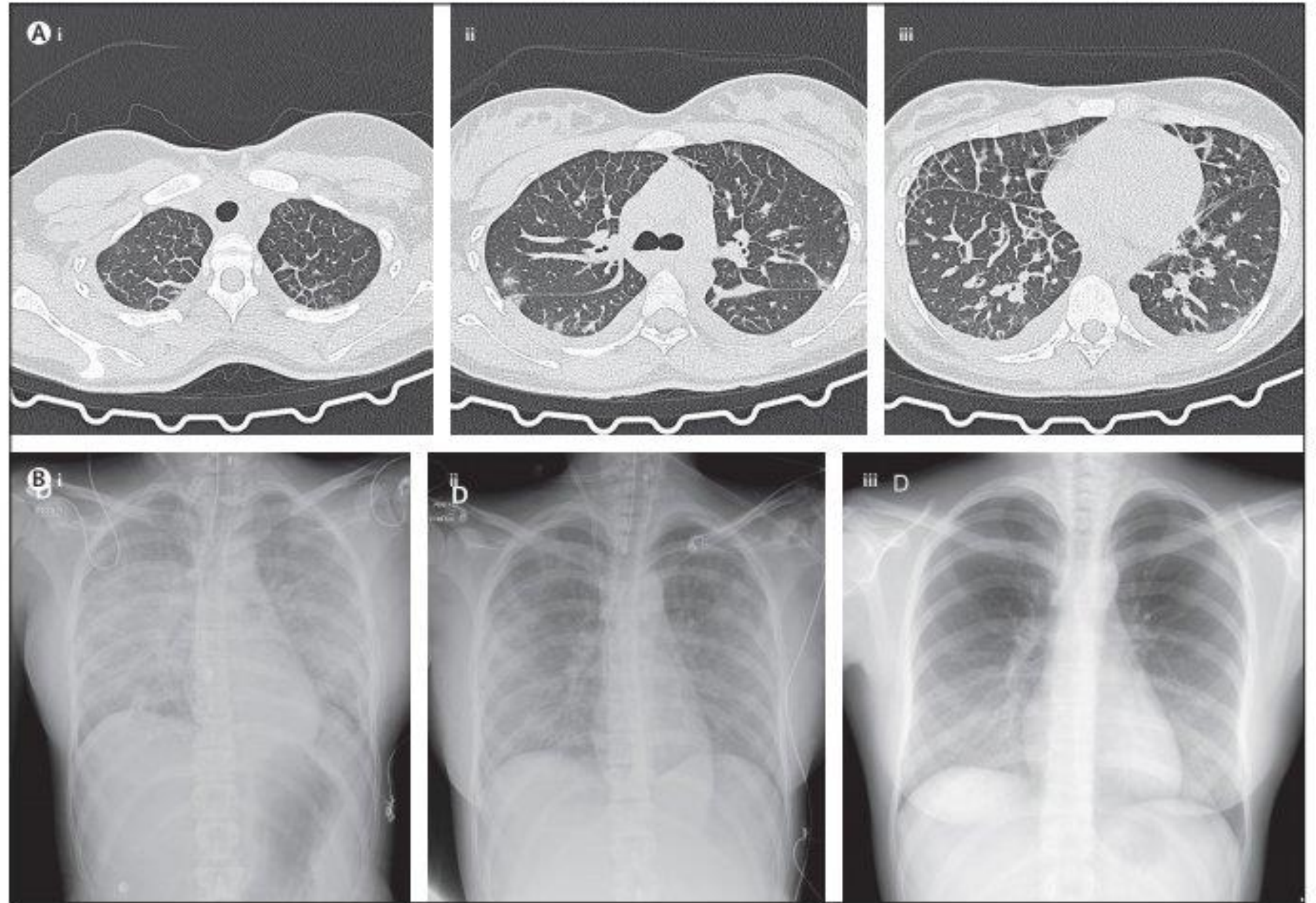


Figure 4: Chest images during the clinical course of hantavirus cardiopulmonary syndrome

(A) Representative CT scan of the chest, obtained at hospital admission in a patient with hantavirus cardiopulmonary syndrome in the cardiopulmonary phase.

(Ai) Apical level, (Aii) carinal level, and (Aiii) basal level. The usual findings are marked bilateral septal thickening, and ground-glass opacities and pleural effusions.

(B) Typical evolution of pulmonary opacities in chest x-ray images at different clinical time courses: (Bi) the acute phase starting mechanical ventilation, (Bii) weaning off mechanical ventilation, and (Biii) when extubated.

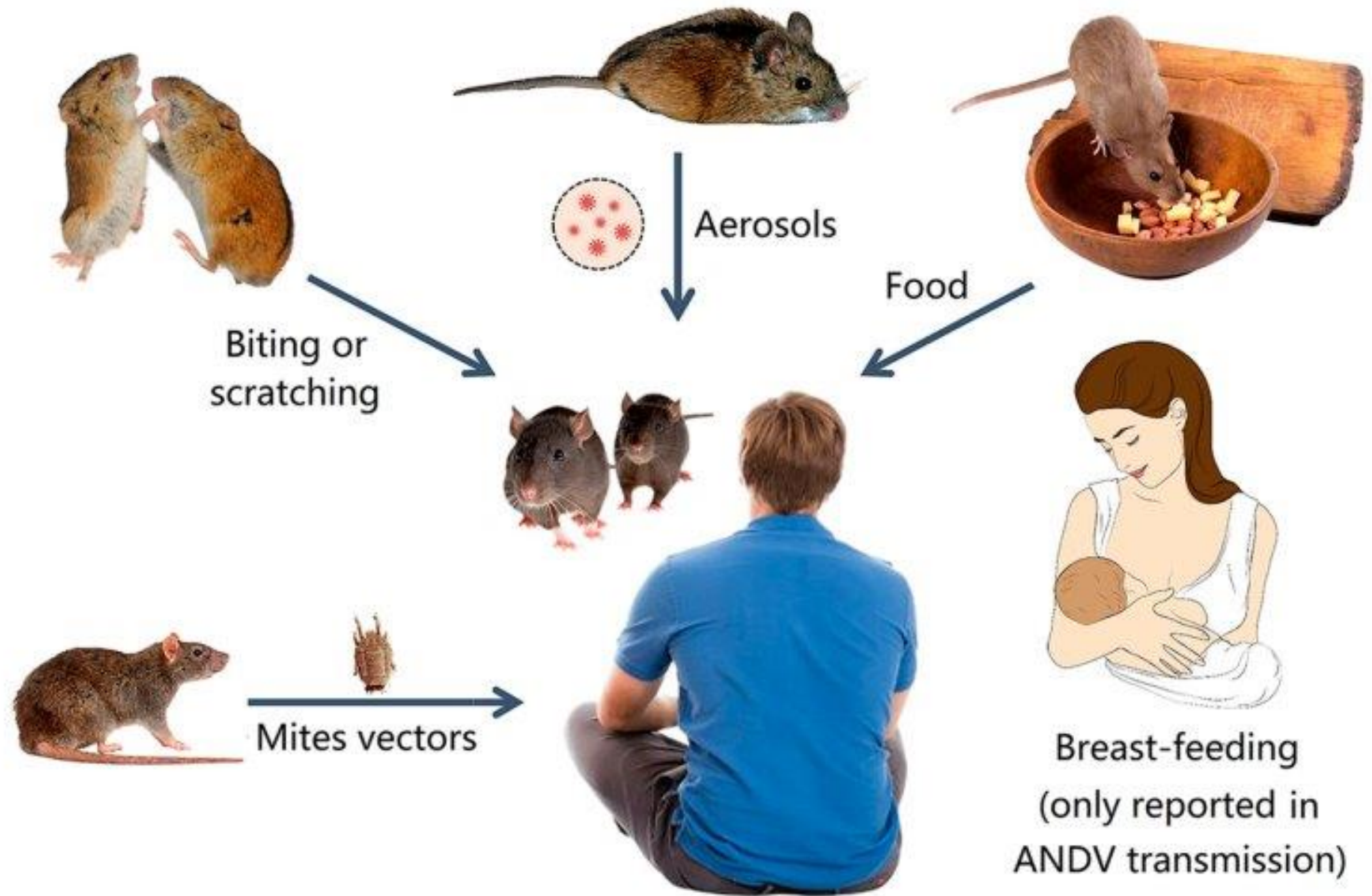


Figure 5. Transmission routes of some hantaviruses in animals and humans.

| | Rodent host | Syndrome | Case fatality rate (%) | Country |
|------------------------|---|-------------|------------------------|---|
| The Americas | | | | |
| Sin Nombre virus | <i>Peromyscus maniculatus</i> | HCPS | 35% | USA, Canada |
| Andes virus | <i>Oligoryzomys longicaudatus</i> | HCPS | 21.4–35.9% | Argentina, Chile |
| Araraquara virus | <i>Bolomys lasiurus</i> | HCPS | 44.5% | Brazil |
| Choclo virus | <i>Oligoryzomys fulvescens</i> | Fever, HCPS | 12–15% | Panama |
| Laguna Negra virus | <i>Calomys laucha</i> , <i>Calomys callosus</i> | Fever, HCPS | 11.7% | Paraguay, Argentina, Bolivia, Peru |
| Juquitiba virus | <i>Oligoryzomys nigripes</i> | HCPS | 32.5% | Brazil |
| Europe and Asia | | | | |
| Hantaan virus | <i>Apodemus agrarius</i> | HFRS | 1% | China |
| Puumala virus | <i>Myodes glareolus</i> | HFRS (NE) | 0.1–0.4% | Finland, Sweden, Belgium, Germany, France, Russia, northeast Europe |
| Dobrava virus | <i>Apodemus flavicollis</i> , <i>Apodemus ponticus</i> | HFRS | 9.8–12.0% | Balkans, southeast Europe |
| Seoul virus | <i>Rattus norvegicus</i> | HFRS | <1% | Worldwide |
| Tula virus | <i>Microtus arvalis</i> | HFRS | .. | Russia, Europe |

All information was obtained from several sources.^{8,19-28} HCPS=hantavirus cardiopulmonary syndrome. HFRS=haemorrhagic fever with renal syndrome. NE=nephropathia epidemica.

Table: Common or important hantaviruses causing disease in the Americas, and Europe and Asia

Environmental Stability



~10 days
at room temperature
(20–25°C)



18 days
at 4°C



**Environmental stability
facilitates transmission.**

Hantaviruses Can Be Inactivated By:



Heat
(60°C for 30 min)



Organic solvents



**Hypochlorite
solutions**



**Ultraviolet
(UV) light**

Protect yourself from Hantavirus



Keep your home and surroundings **clean**



Seal openings and keep rodents out



Use safe cleaning practices



Wash your hands **regularly**



Avoid contact with rodent urine, droppings, or nesting materials.





Ebola

Prof. Davood Yadegarynia

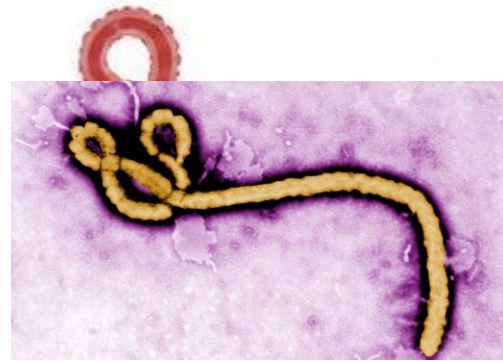
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Ebola Disease



Cause:
Orthoebolaviruses
(formerly
ebolavirus)



**Serious illness –
without treatment
can cause death**



**Discovered in 1976 –
Democratic Republic
of the Congo**

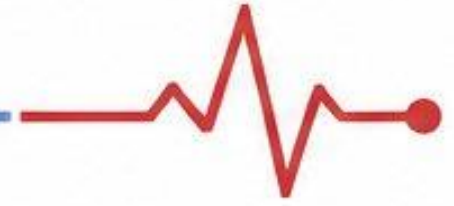


**Found mainly in
Sub-Saharan Africa**



Bundibugyo, the rare virus causing a deadly new Ebola outbreak, has no vaccine yet.

Ebola Signs and Symptoms



**Exposure to
*Orthoebolavirus***



Symptoms appear
2–21 days (avg 8–10)

Early “Dry” Symptoms



Fever



Aches & Pains



Fatigue



Later “Wet” Symptoms



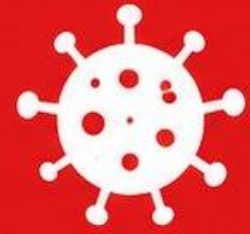
Diarrhea



Vomiting



Unexplained
Bleeding



Risk Factors



Caring for Ebola patients
without proper
infection control



Healthcare
providers



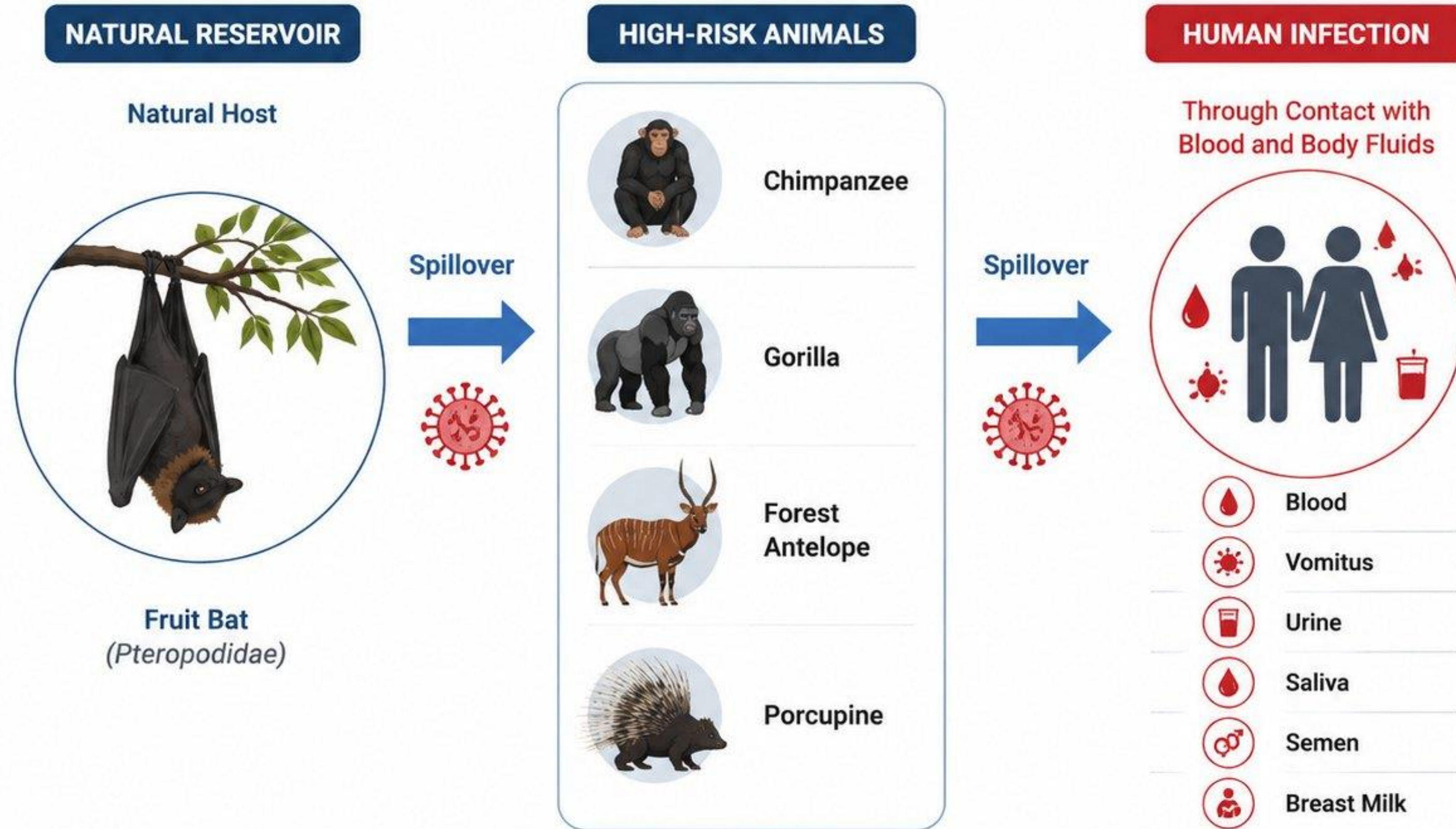
Family
members
caring for
patients



Little risk for travelers
and the general public

EBOLA VIRUS TRANSMISSION

Ebola virus disease (EVD) is a severe, often fatal illness in humans. It spreads to people through contact with infected animals or humans.



Ebola Prevention

Key Actions

 Avoid Body Fluids

Blood, urine, feces, saliva, sweat, vomit, breast milk, amniotic fluid, semen, vaginal fluid

 Avoid Contaminated Items

Clothes, bedding, needles, medical equipment, and other contaminated objects

 Avoid Potential Animal Sources

Bats, forest antelopes, primates, and their blood, fluids, or raw meat

 Avoid Contact with Bodies

Do not touch the body of a person suspected or confirmed to have Ebola