

Hantavirus Pulmonary Syndrome (HPS) in British Columbia:

Are Population Dynamics of the North American Deermouse
(*Peromyscus maniculatus*) driving cases in humans?

Quinn Stewart, Epidemiologist

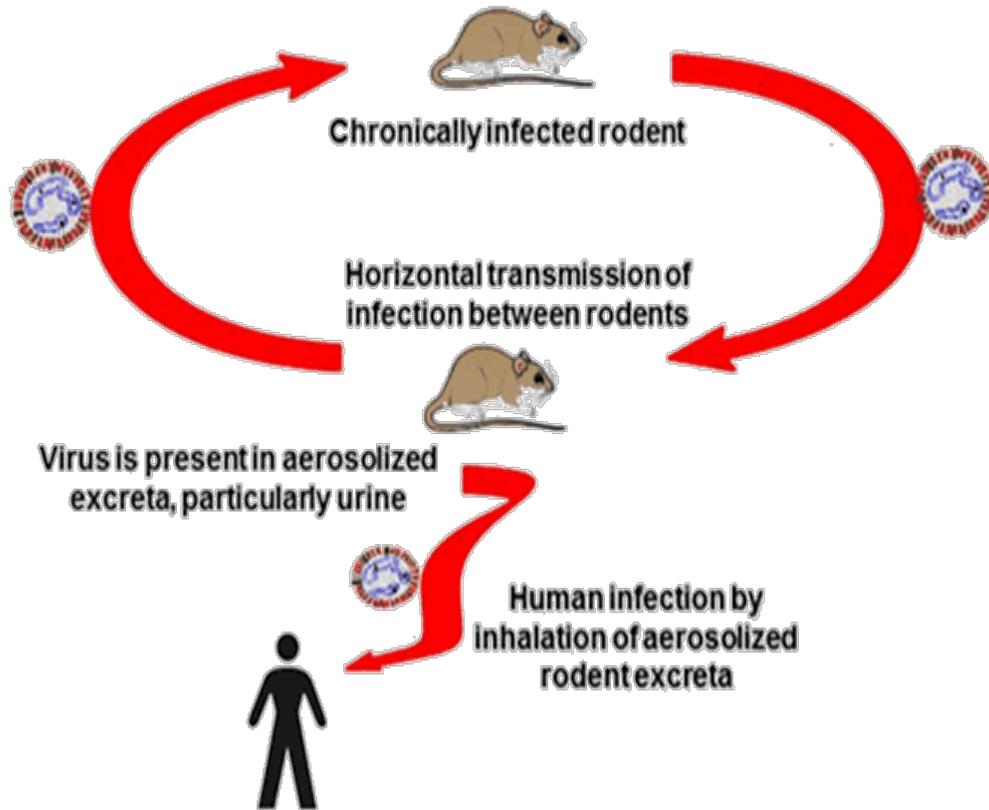
Mayank Singal, Physician Epidemiologist

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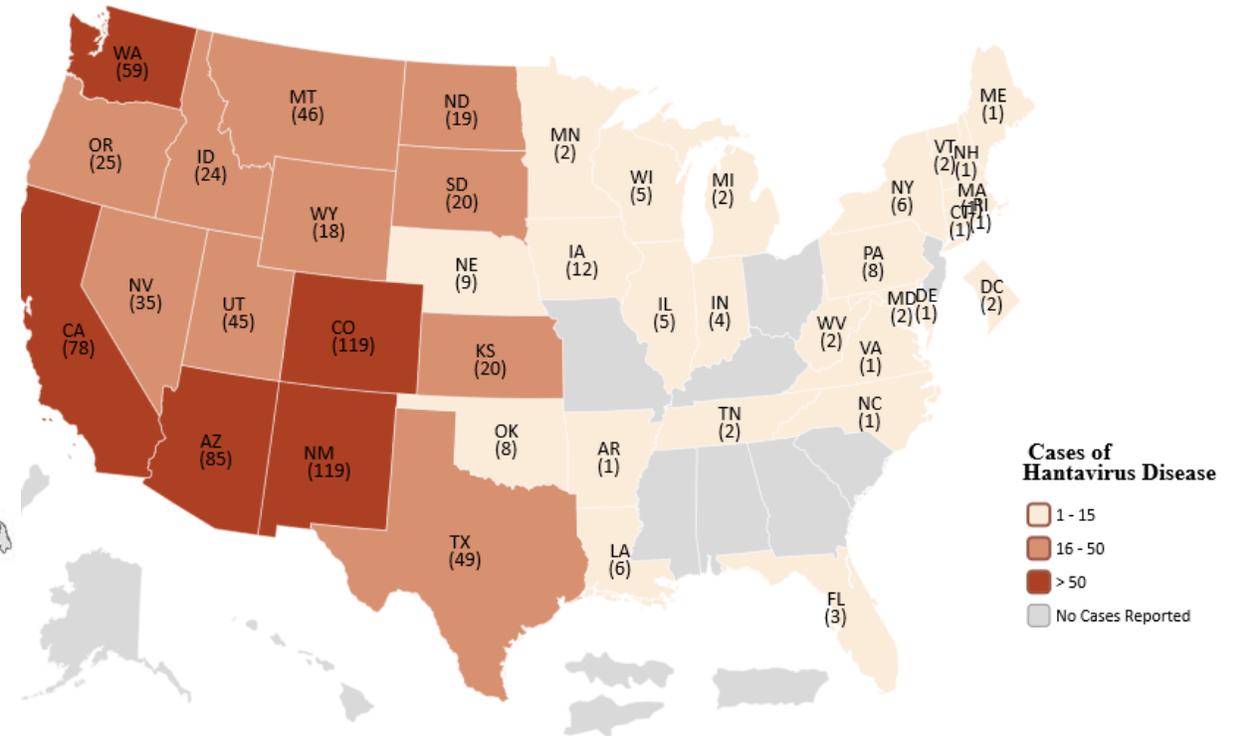
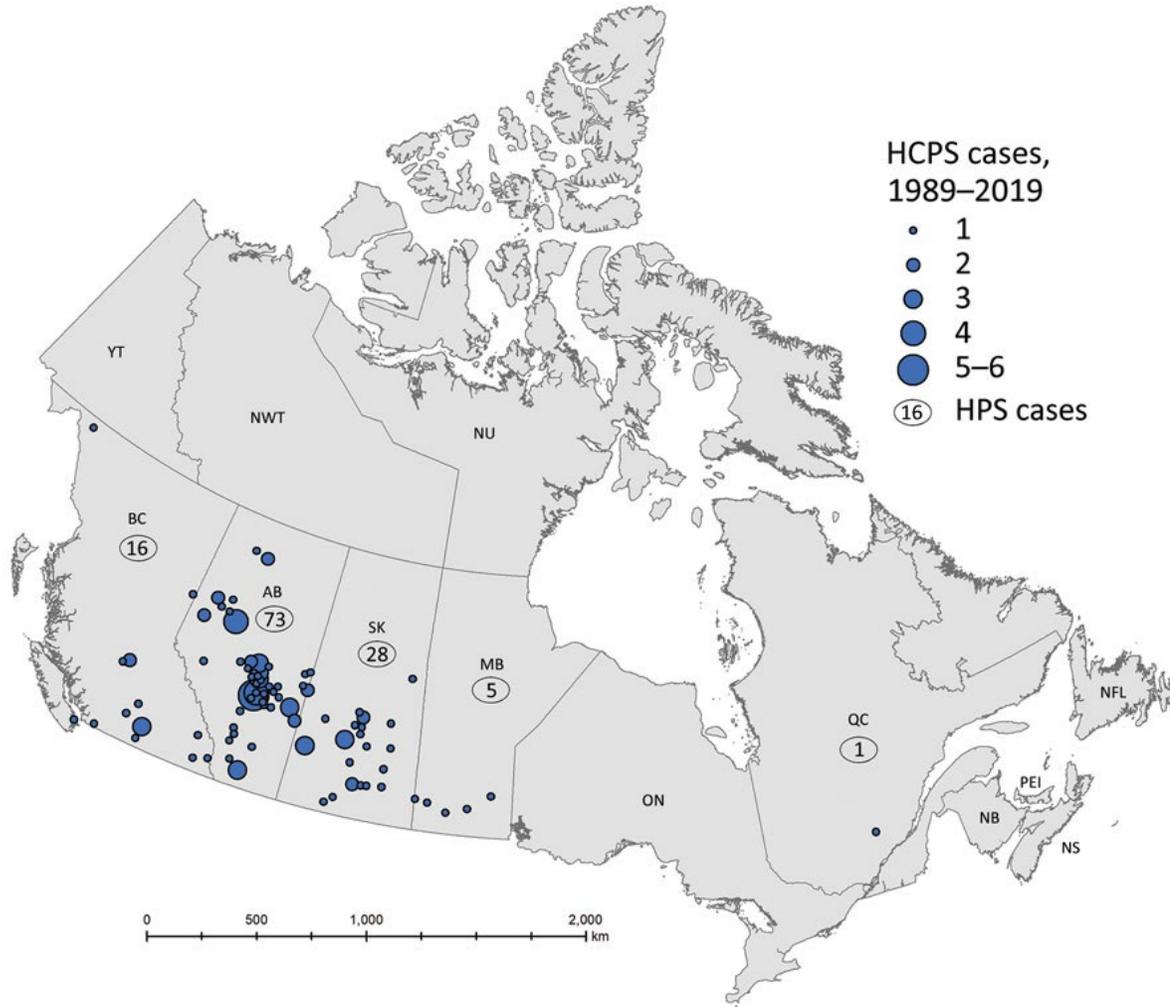
BC Centre for Disease Control
Provincial Health Services Authority

Hantavirus Pulmonary Syndrome



- Virus is primarily acquired by inhaling aerosolized rodent urine, saliva and/or feces
- Initial prodrome of flu-like symptoms and gastrointestinal symptoms followed by severe respiratory illness with a high case fatality rate (30-35%)
- Seroprevalence? 1% in some US states
- The predominant strain in North America is *sin nombre*, where deer mice are the primary reservoir.

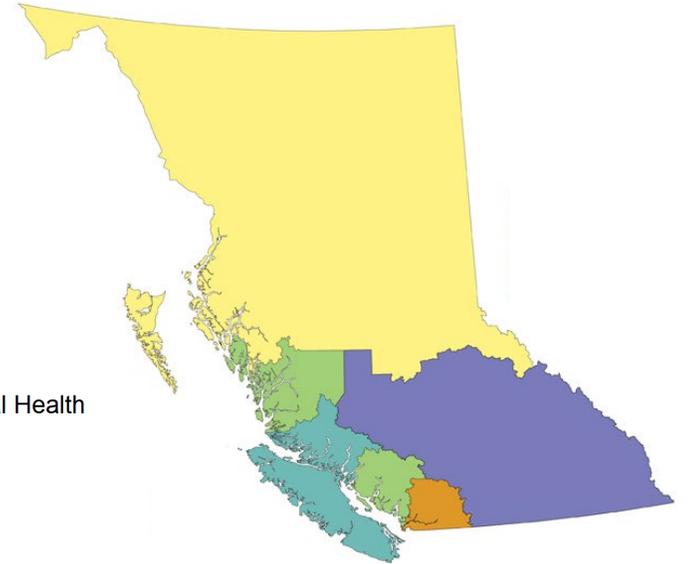
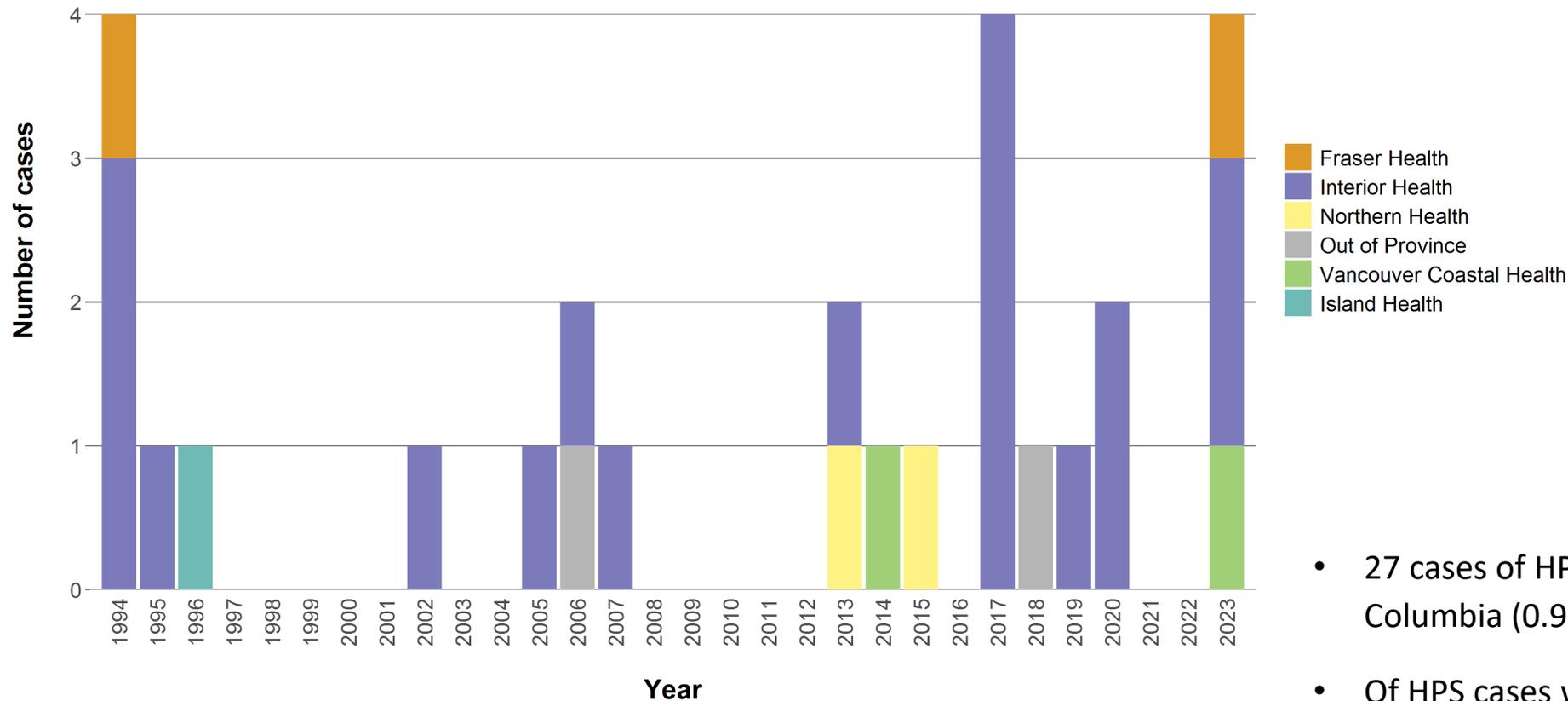
Hantavirus cases in Canada & US



Warner et. al, 2020, Emerging Infectious diseases

CDC 2023

Incidence and Distribution of HPS in British Columbia

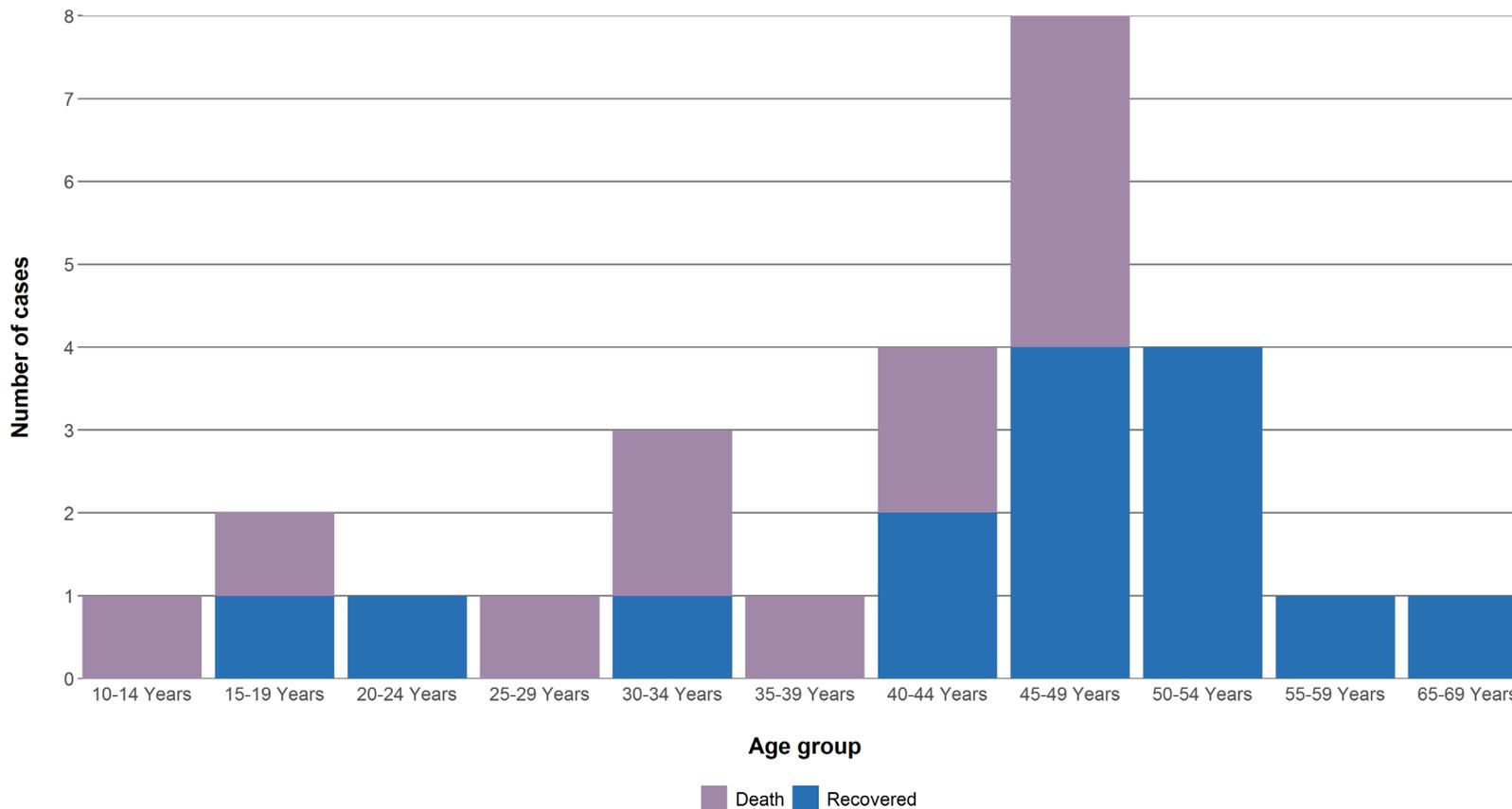


Government of British Columbia. *Health authority area boundaries in B.C.*

Figure 1. Confirmed Cases of Hantavirus Pulmonary Syndrome in British Columbia By Regional Health Authority, 1994-2023 (Year-To-Date).

- 27 cases of HPS have been reported in British Columbia (0.9 cases per year).
- Of HPS cases with available data, 70% (14/20 cases) were reported during the warmer months (May-September).

HPS Cases in British Columbia by Age and Outcome



- Confirmed cases of HPS range from 14 to 69 years old, with a median age of 46 years.
- The mortality rate amongst BC cases has been 44.4% (12/27 cases).
- Cases that resulted in death were generally younger (median age of 43.5 years) compared to cases that recovered (median age of 49 years).
- Of the recovered cases with available data (9/15), all were admitted to the hospital and had lengths of stay ranging from 1 to 16 days (median length of stay of 6 days).

Figure 2. Confirmed Cases of Hantavirus Pulmonary Syndrome in British Columbia By Age Group and Outcome, 1994-2023 (Year-To-Date).

The North American Deermouse (*Peromyscus maniculatus*)

- Nocturnal rodents present throughout most of North America^{4,5}.
- Population density is generally lowest in the spring and highest in the fall⁶.
- Breeding tends to occur from March to October, although North American deermouse breeding tends to be determined more by food availability rather than by season⁷.
- Occupy a wide variety of habitats, from open areas and brushland to coniferous and deciduous forests⁸.
- Their nest sites may be placed in buildings, burrows, under logs, in thick vegetation, or in tree cavities⁸.
- Most travel less than 500 feet from the natal area to establish their own home range⁹.
- Very short life spans, usually less than 1 year¹⁰.



P. maniculatus

Factors Impacting Foraging Ability of *P. maniculatus*

Fire

- Lodgepole pine, present throughout British Columbia, have serotinous cones that require heat for germination¹¹.
- Burned, structurally simplified habitat increases foraging efficiency and reduces competition¹².
- In montane and boreal forests, most postfire conifer recruitment occurs in the first 2-3 years after fire¹³.
- Deermice have exhibited a positive response to fire in forest and prairie habitats and a negative response to fire in desert habitats^{14,15}.

Masting

- ➔ The widespread and synchronous production of large seed crops.
- Commonly used by North American conifers (e.g. Ponderosa pine, Douglas fir, Western hemlock) to reproduce¹⁶.
- Interval between mast years depends on the species of tree.
- *Picea* spp. (e.g. white spruce, Sitka spruce) mast every 2-6 years, synchronizing seed production over distances of up to 2500km^{16,17}.
- There are various hypotheses surrounding why this phenomenon occurs, including climate cues and pollen coupling.
- Increased seed ability during mast years increases food ability and decreases competition for resources.

Predicting Risk of Nephropathia Epidemica From Bank Vole (*Myodes glareolus*) Population Dynamics

- The bank vole (*Myodes glareolus*) fluctuates in population density every 3-4 years in Nordic Countries¹⁸.
- The number of annual cases of nephropathia epidemica (NE) has been shown to be closely linked to the abundance of bank voles in Finland¹⁹, Sweden^{20,21}, and Central and Western Europe^{22,23}.



M. glareolus

- In temperate Europe, NE risk can be predicted based on weather conditions that promote masting of broad-leaved trees such as oak and beech up to 2 years in advance²⁴.
- Research based on human risk of NE and bank vole density found potential NE outbreaks can be predicted using the density of bank voles 18 months earlier²⁵.
 - Overall bank vole density and the density of infected bank voles in spring was a linear predictor of NE incidence in summer²⁵.
 - Overall bank vole density in autumn was a good nonlinear predictor of NE incidence in winter²⁵.

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Thank you

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