

One Health: From Paradigm to Precision

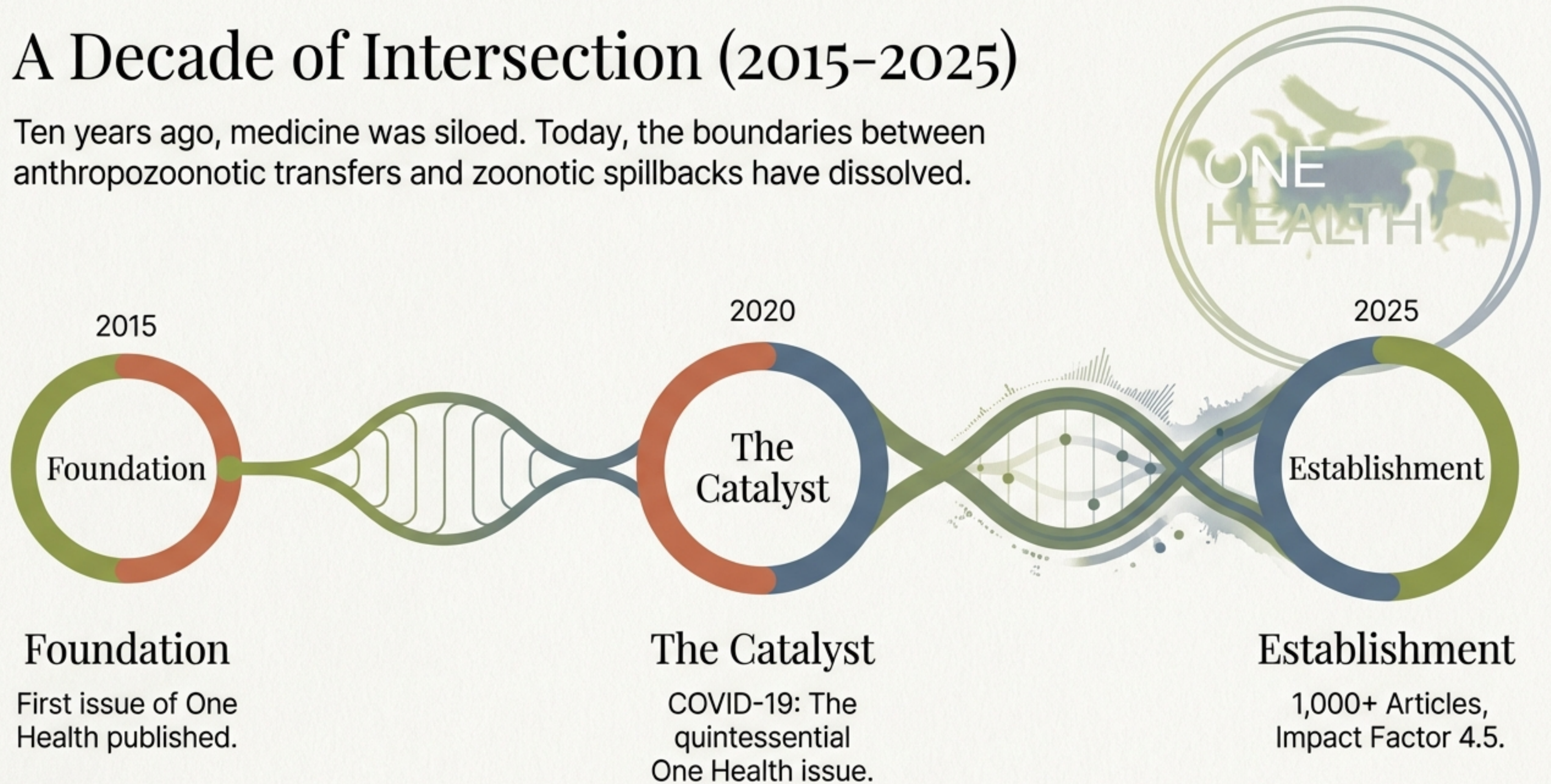


Integrating Mathematical Modeling, Spatial Epidemiology, and Policy for Emerging Zoonoses

Human well-being cannot be considered in isolation from the environments we share.

A Decade of Intersection (2015–2025)

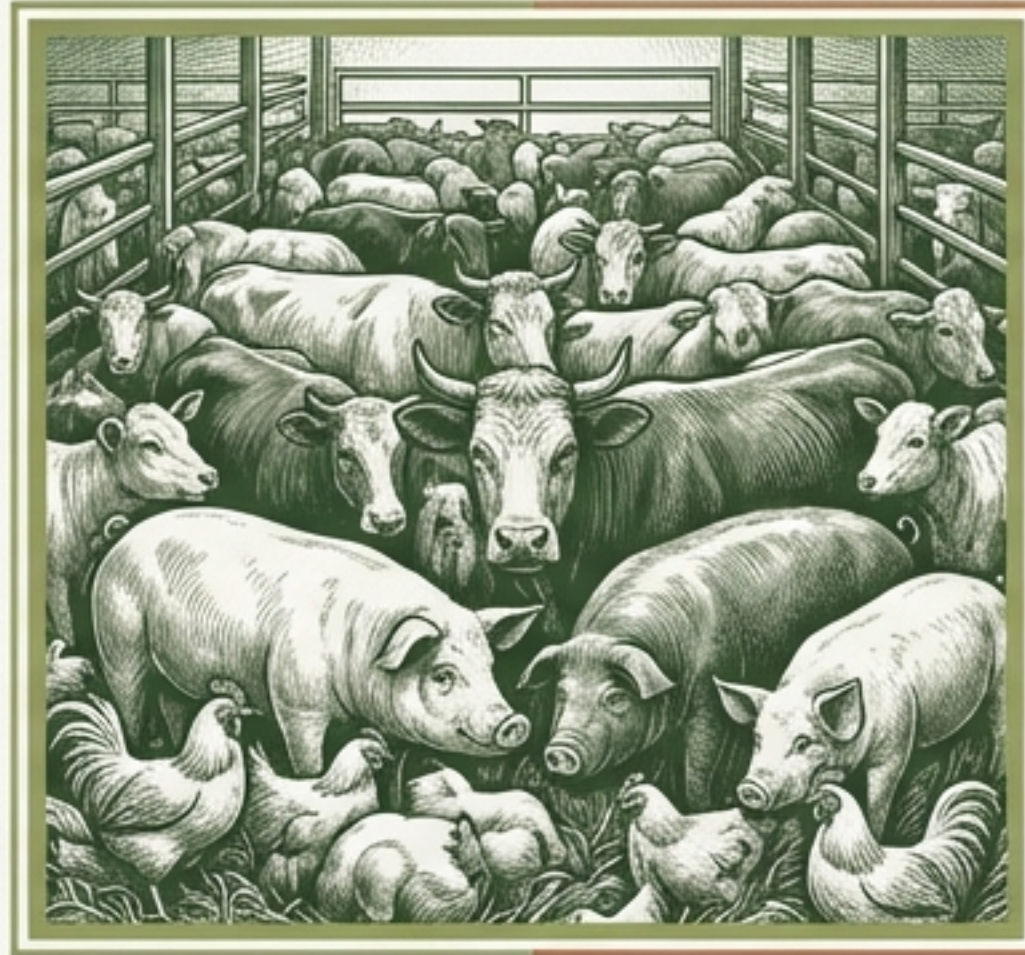
Ten years ago, medicine was siloed. Today, the boundaries between anthropozoonotic transfers and zoonotic spillbacks have dissolved.



The Triad Under Pressure



Environmental Degradation
Deforestation & Climate Change



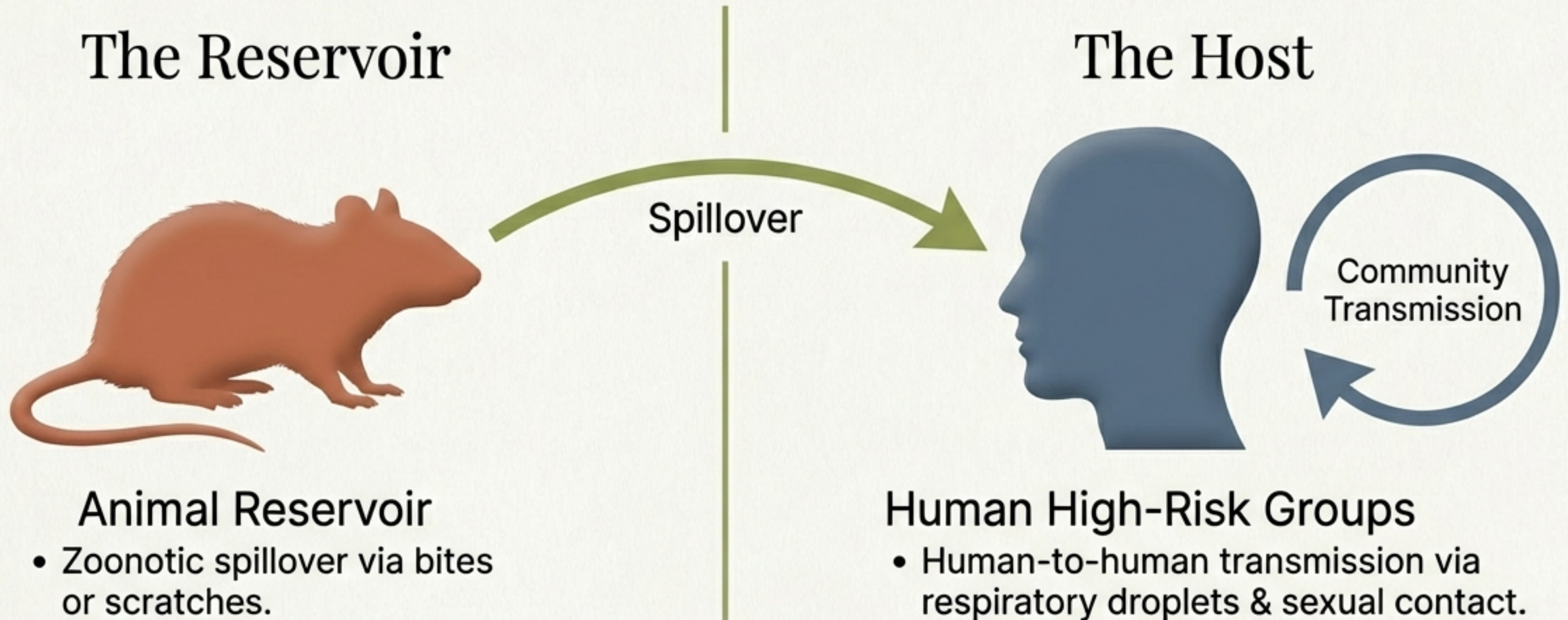
Food Systems
Production Pressure & AMR



Globalization
Encroachment & Transit

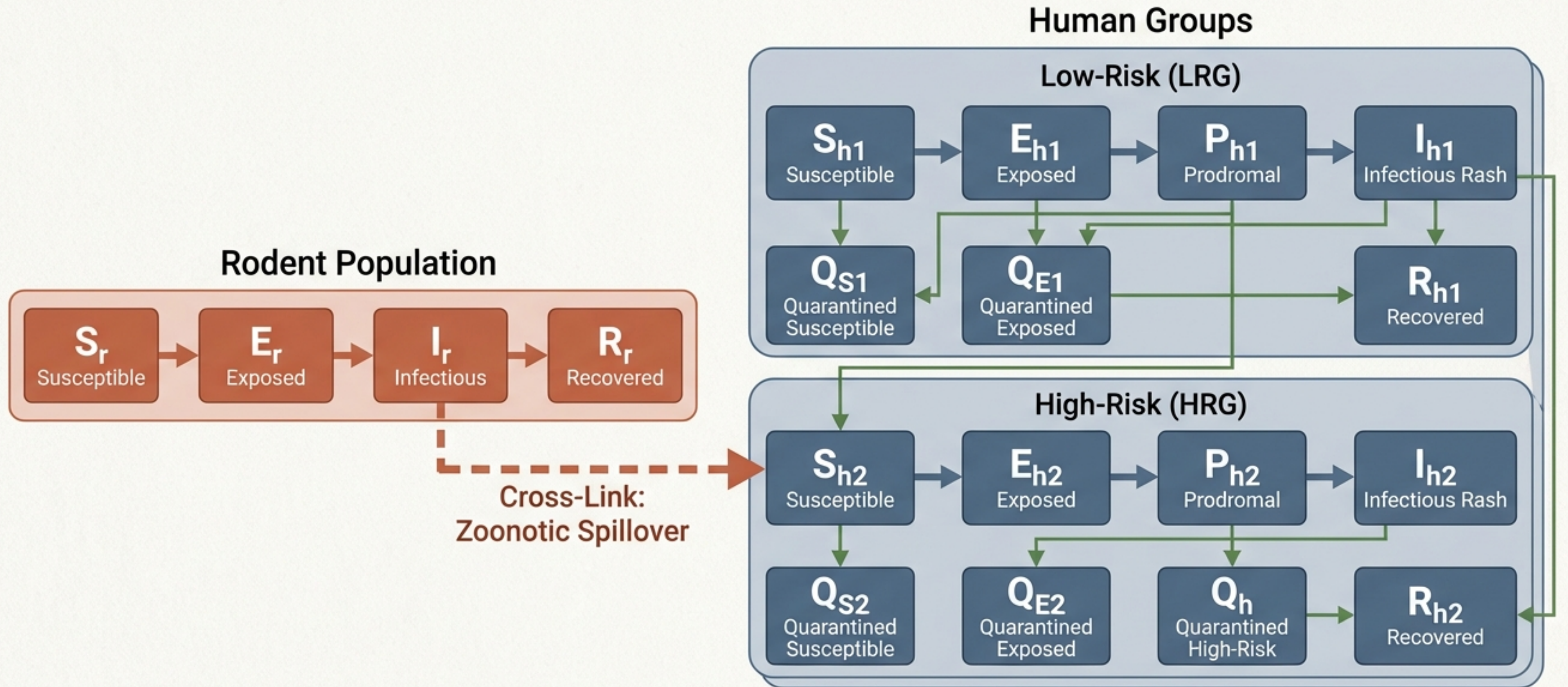
“Climate change is a health emergency for humans, animals, and the environment.”

The Case Study: Monkeypox (MPX)



Current outbreaks show distinct patterns in gay, bisexual, and other men-who-have-sex-with-men (gbMSM), distinct from previous endemic behavior.

Modeling the Invisible Networks



The Mechanics of Spillover

High Risk Group R0

1.2 – 1.5

Playfair Display

Baseline Reproduction
Number

Low Risk Group R0

< 1

Playfair Display

Transmission Probability
~0.5%

Incubation Period

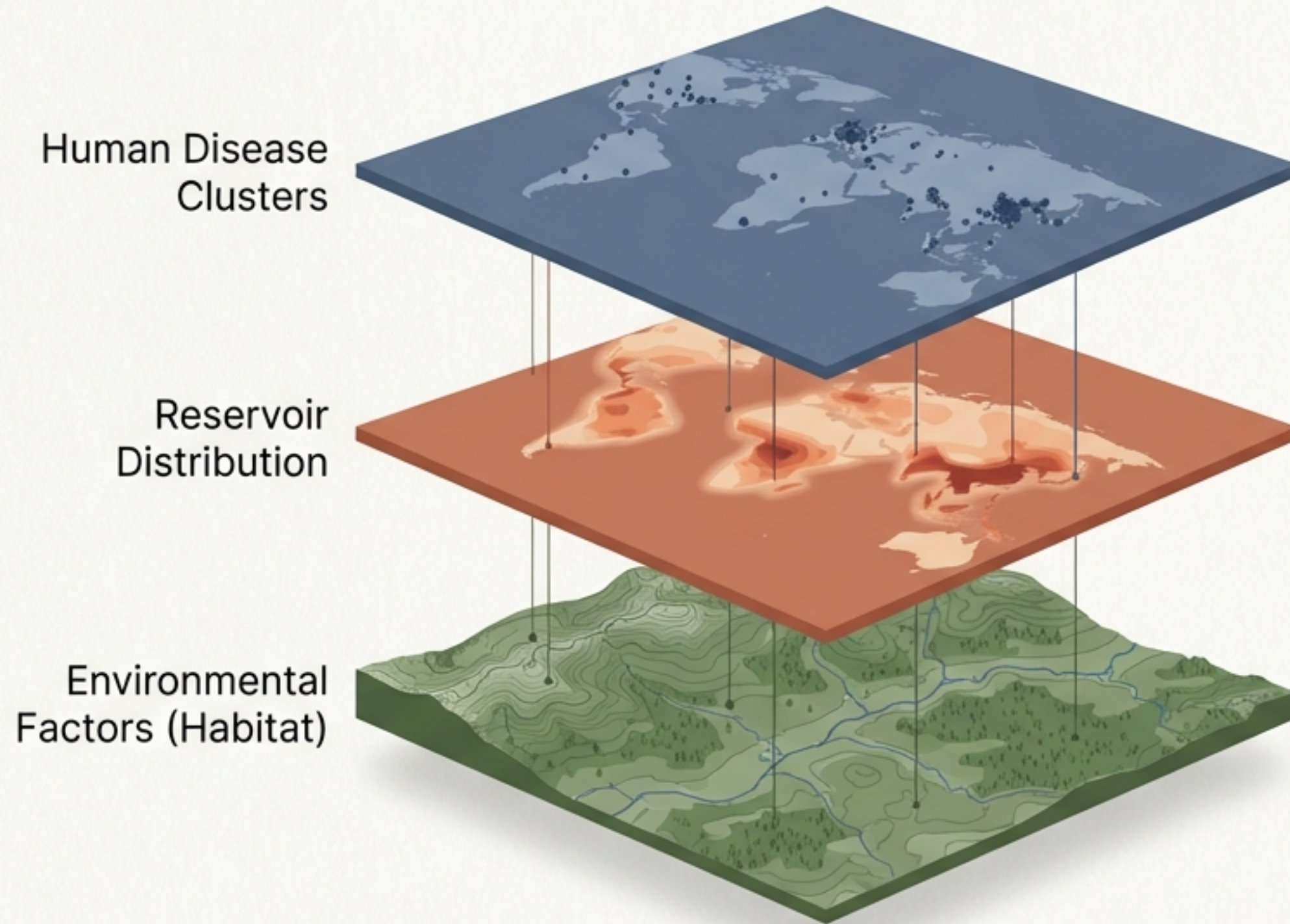
~13 Days

Playfair Display

Time from exposure to
symptoms

Spillover is driven by interaction. A viral mutation increasing transmission efficiency by just 50% causes risk to the general population to skyrocket.

The 'Where' and the 'Why'



Spatial Epidemiology moves beyond simple incidence rates.

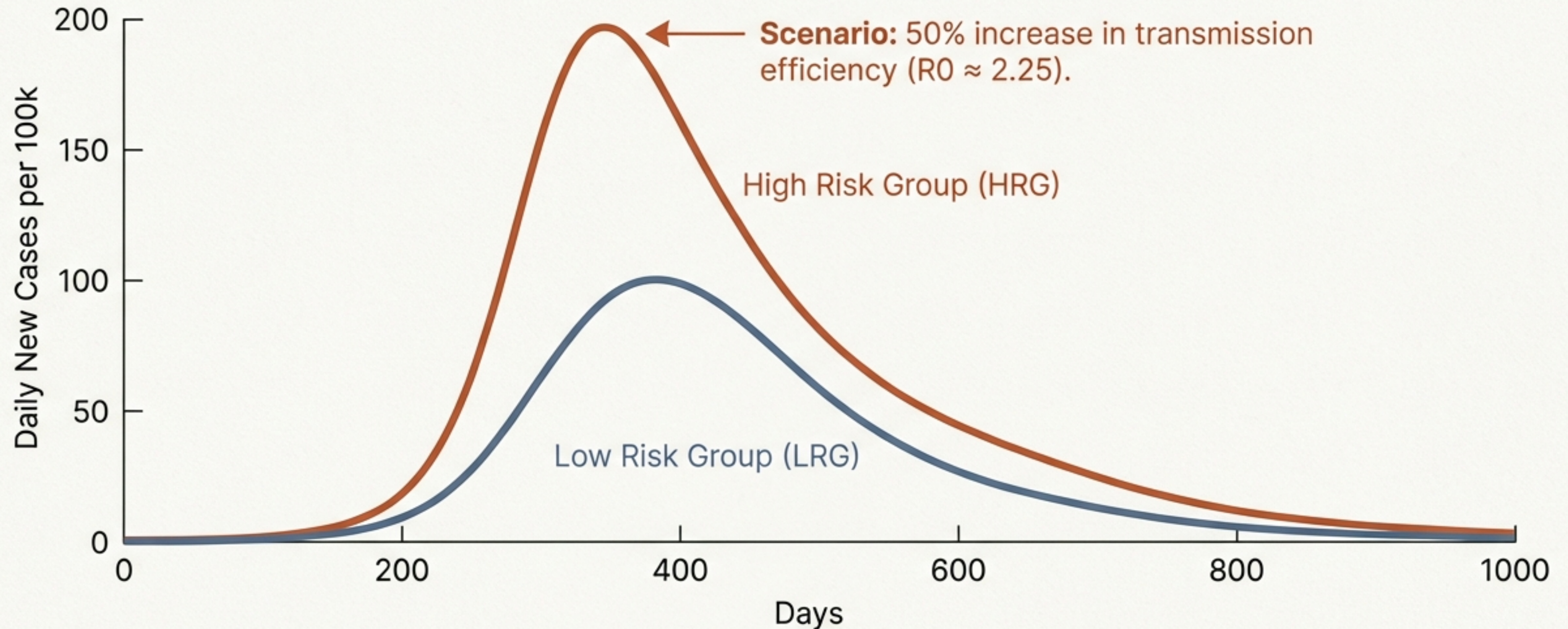
It integrates geography and ecology to understand **Landscape Epidemiology**—how the physical environment constrains or facilitates the vector range.

Mapping the Risk Landscape

Using GIS to predict outbreaks by identifying the intersection of human cases with environmental suitability, similar to tracking Swine Viral Disease.



The Threat of Increased Efficiency



This visual represents the 'Nightmare Scenario' where no contact tracing is used, illustrating the potential for rapid and widespread infection.

The Critical Threshold

65%

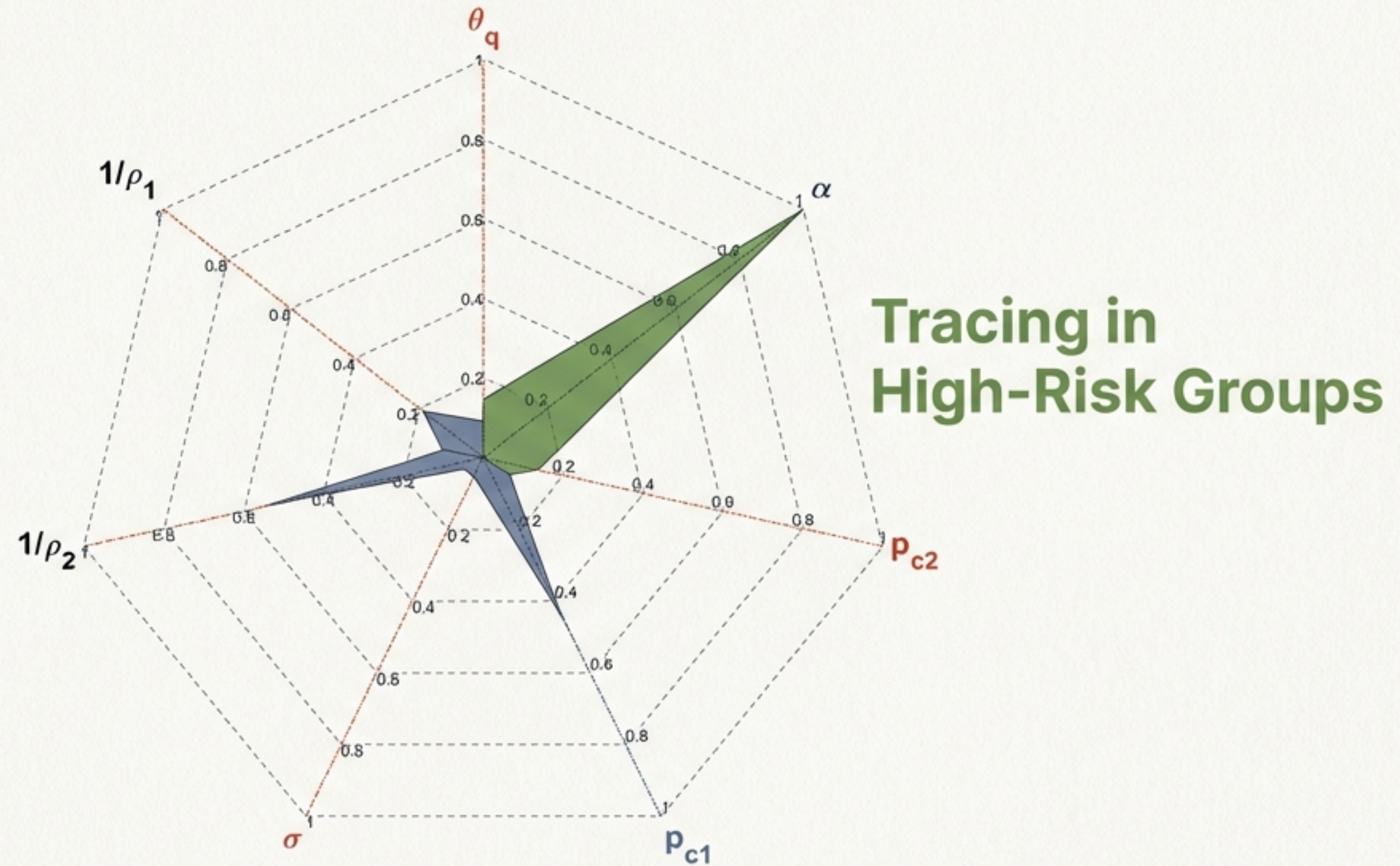
Symptomatic Isolation Target

Mathematical modeling confirms that if 65% of symptomatic cases (those with rash) are effectively isolated, the transmission chain breaks.



Visual Footnote: Flattening the curve through targeted isolation.

The Precision of Contact Tracing



Tracing 60% of contacts in the High-Risk Group flattens the curve even if viral transmission increases. Generalized tracing is far less effective.

Protection vs. Stigma

The Dilemma:

Controlling MPX requires targeting the gbMSM community where $R_0 > 1$.

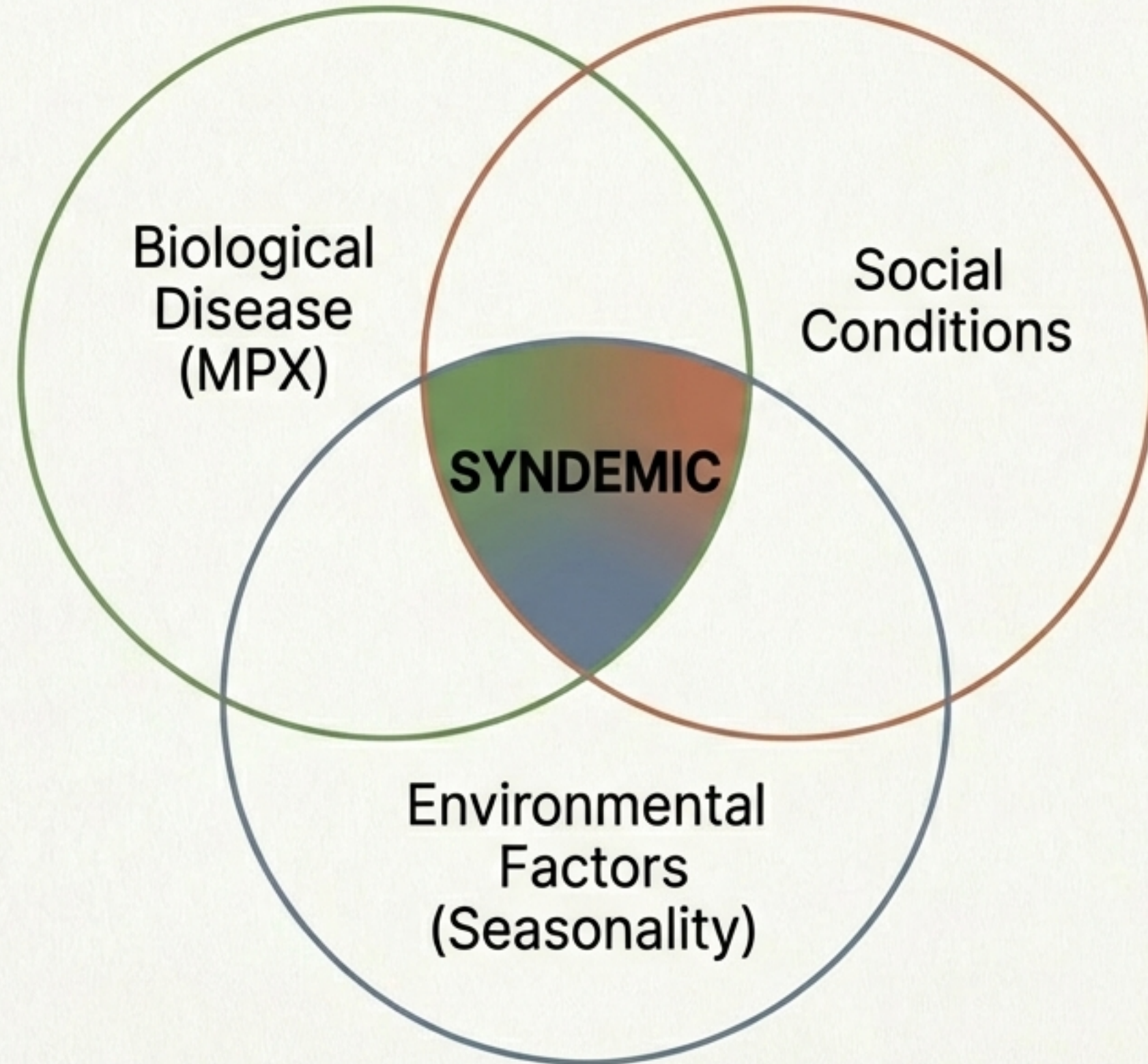


The Risk:

Stigma delays medical seeking behavior.

The solution is empowerment. Risk depends on exposure levels, not identity.
Communication must be frank, targeted, and destigmatizing.

Beyond the Single Disease: Syndemics



Animal Surveillance:
Monitoring rodent birth pulses (April-August).

Spatial Lifecourse Epidemiology: Tracking health over time and space.

Synergy: Biological and social factors interact to amplify risk.

The Quadripartite Framework



The One Health Joint Plan of Action (2022-2026). Implementing top-down multidisciplinary strategies integrated with local community knowledge.

One and Indivisible



The Math

Target: 65% Isolation

The Map

Tool: Spatial Epidemiology

The Mandate

Policy: One Health Framework

Sustainable practices are central to preventing future outbreaks. The health of people, animals, and the environment is one.