Food and Agriculture Organization of the United Nations

World Organisation for Animal Health

China, Mongolia, and Central Asia Episystem Workshop for Peste des petits ruminants (PPR) eradication

Ulaanbaatar, Mongolia, 1-3 April 2025

With support from:

中华人民共和国农业农村部
Ministry of Agriculture and Rural Affairs of the People's Republic of China

Funded by the European Union

GF-TADs
GLOBAL FRAMEWORK FOR THE PROGRESSIVE CONTROL OF TRANSBOUNDARY ANIMAL DISEASES

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Surveillance approaches and episystem characterization

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Objective

To discuss how to:

- identify and characterize PPR episystems,
- types of data needed for this process,
- how to design surveillance based on identified episystems.

What are episystems and why are they important?

Episystems: interconnected populations maintaining virus transmission indefinitely.

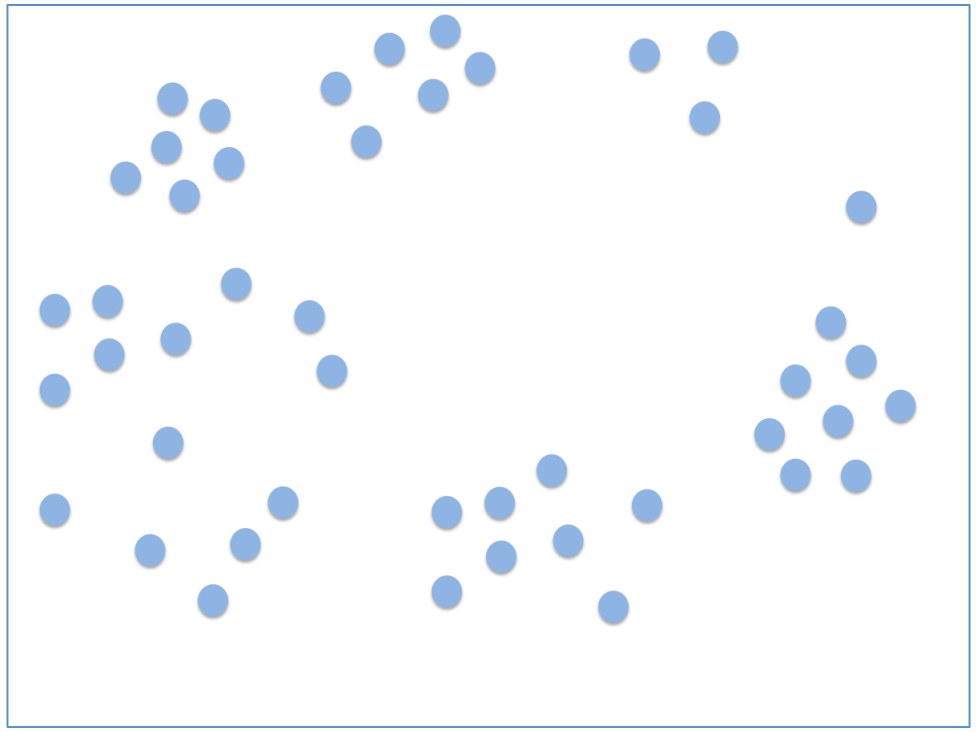
Understanding them allows:

- Identification of populations critical for PPR persistence.
- Targeting surveillance and vaccination to interconnected populations rather than just geographical areas.
- Identify how to break chains of transmission, essential for elimination.

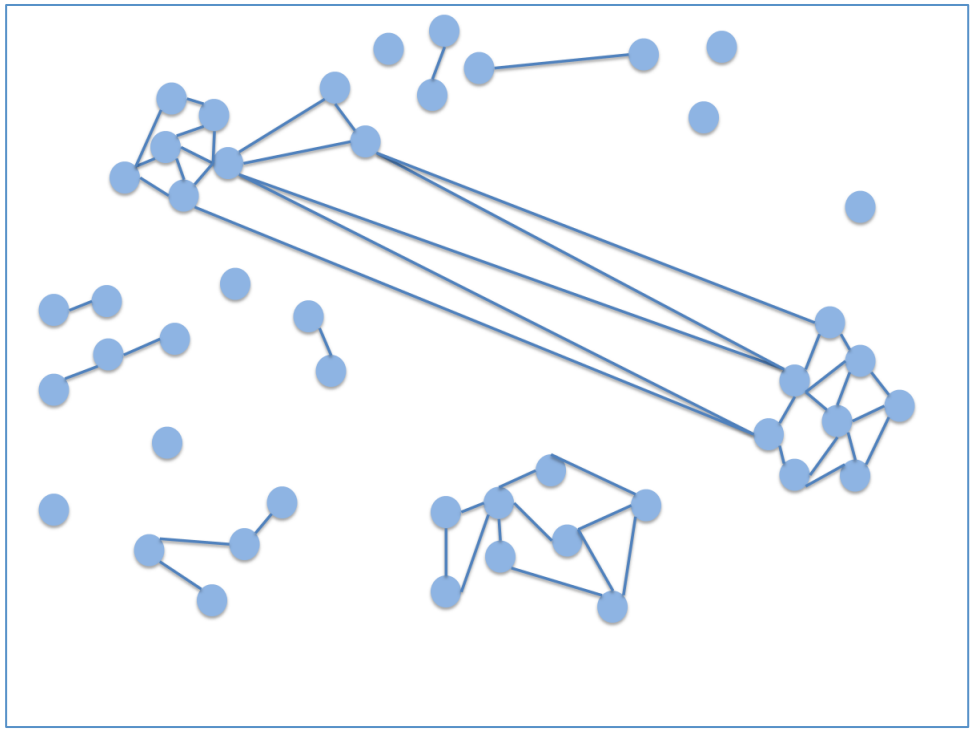
Episystem approach →shift in surveillance & control:

Geographically-based → Epidemiologically-based

From geographically-based to epidemiologically-based surveillance & control

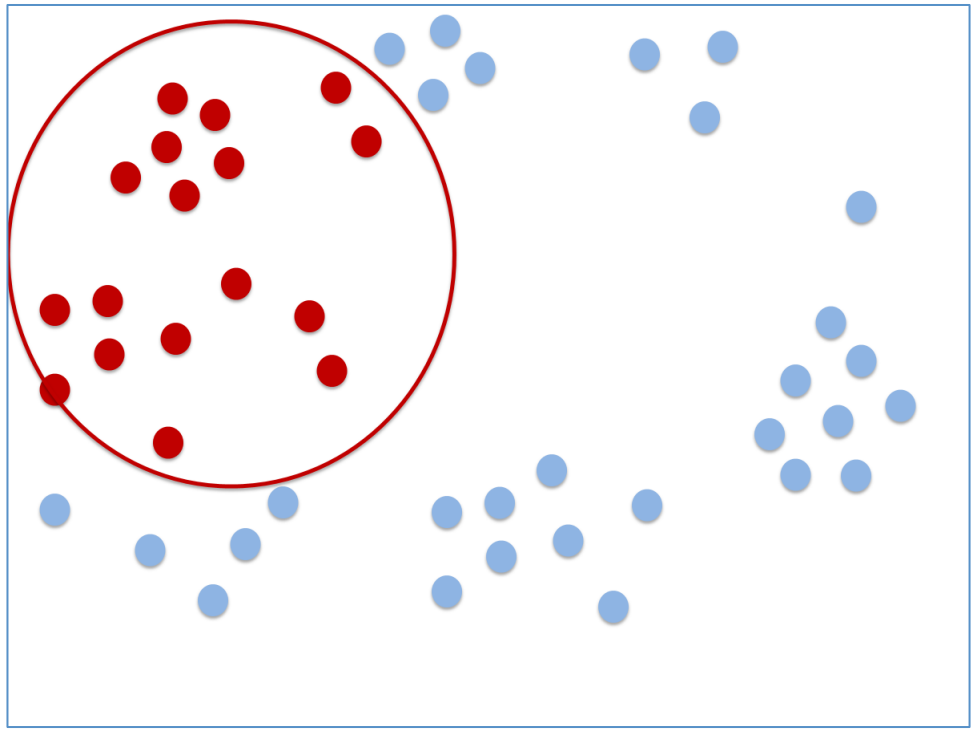


Purely geographical approach – connectivity ignored.



Episystem approach – connectivity considered.

From geographically-based to epidemiologically-based surveillance & control



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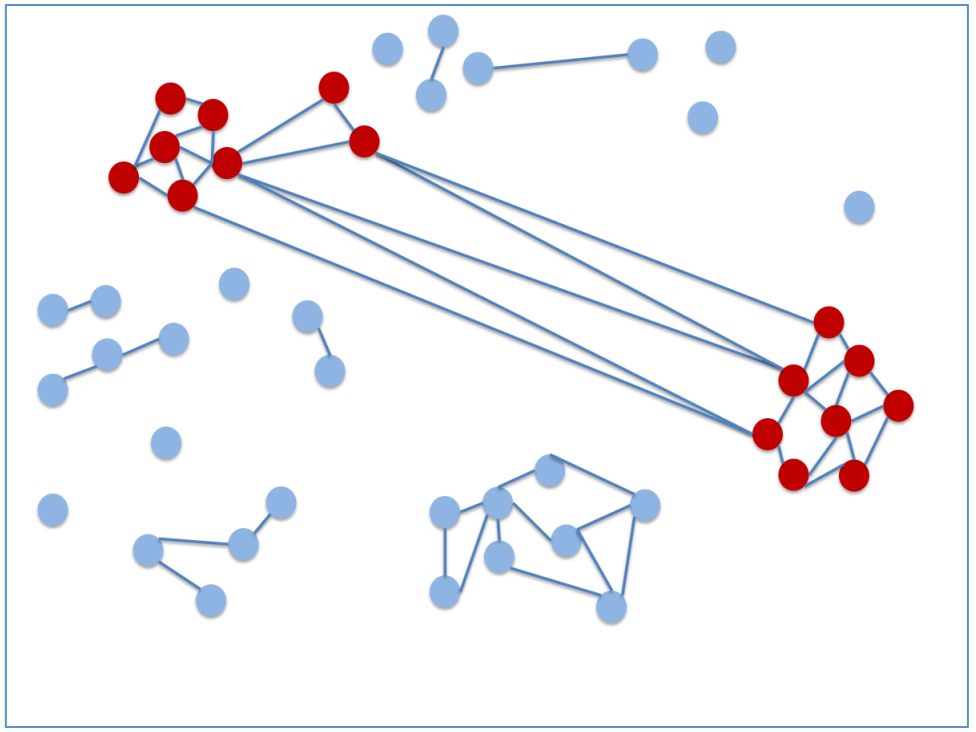
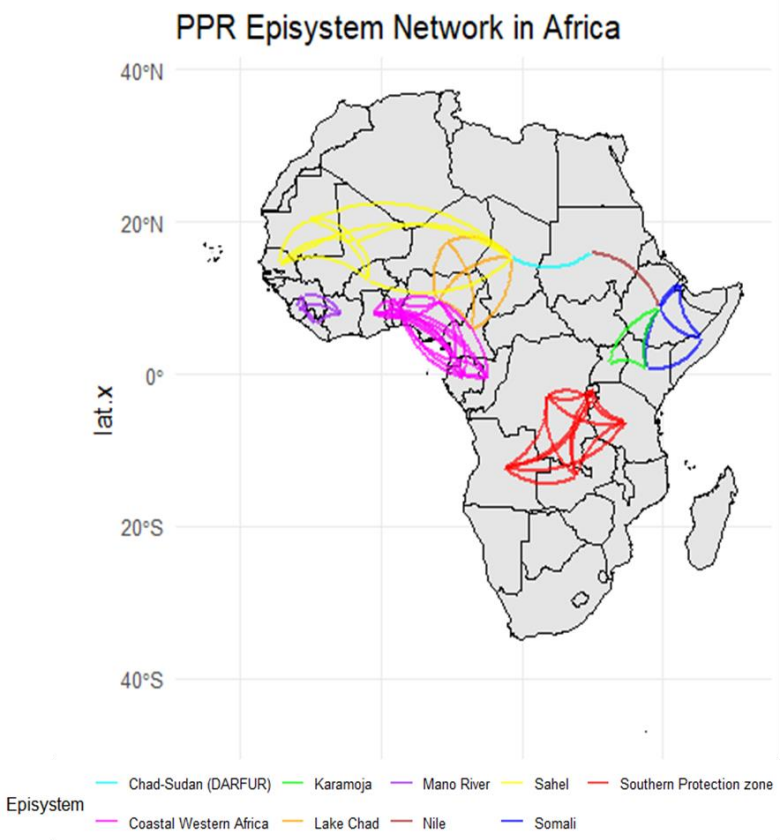


Episystem approach – connectivity considered.

Geographical scale of episystems

Episystems “operate” or “take place” or “can be defined” at different scales: transnational vs. subnational.



Identifying and characterizing episystems

How to Identify and Characterize PPR Episystems:

- Connectivity
- Population dynamics
- Transmission patterns

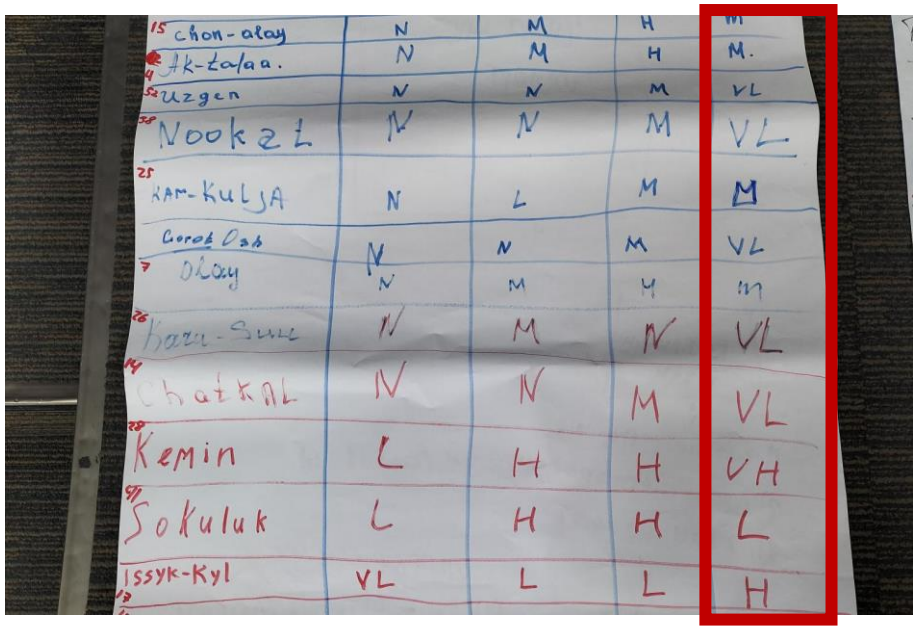
Data sources:

1. Population and movement data
2. Epidemiological data
3. Phylogenetic data

1. Population and movement data for episystem characterization

To map connectivity

- Small ruminant density and distribution
- Movement patterns e.g. seasonal migration (transhumance)
- Livestock trade networks (trading hubs, flows of live animals)
- Geospatial data integration (e.g. integrate census with participatory mapping).



2. Epidemiological data for episystem characterization

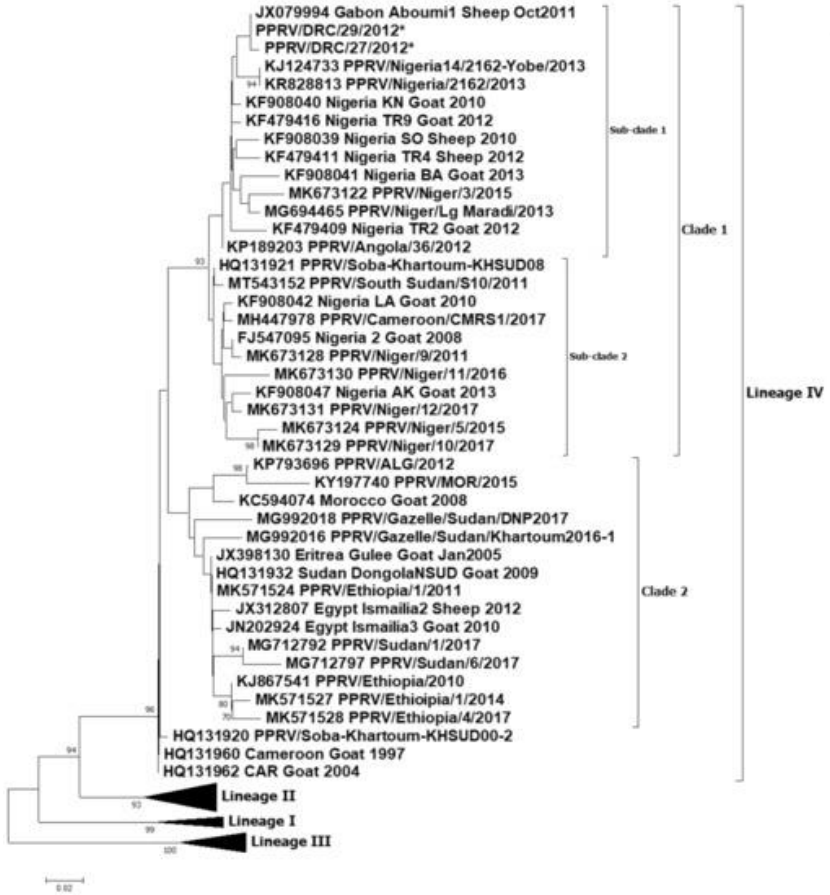
To track transmission events and risk factors

- Surveillance data and outbreak investigations:
  - Spatial patterns
  - Temporal patterns
  - Demographic patterns
- Vaccination coverage (identify immunity gaps).

3. Phylogenetic data for episystem characterization

To identify circulating strains and their transmission pathways:

- Identification of circulating lineages/strains
- Molecular clustering and mapping distribution.
- Refine / validate episystems: link to epidemiological data and verify whether outbreaks within an episystem involve related lineages/strains, confirming interconnectedness.



Neighbor-joining tree constructed using partial N gene sequences of peste des petits ruminants virus (PPRV), showing relationships among the PPRV lineage IV isolates circulating in Africa. Source: Mulumba-Mfumu, et al (2021). https://doi.org/10.3390/v13122373

Surveillance in identified episystems – Passive (scanning) vs. Active (targeted)

Passive (scanning) surveillance: routine data collection, often based on reports form livestock keepers.

Active (targeted) surveillance: Proactive data collection through targeted surveys / investigations.

Surveillance in identified episystems – context-specific approaches

- Syndromic surveillance
- Risk-based surveillance
- Participatory disease surveillance
- Cross-border surveillance
- Wildlife surveillance

Some of these specific approaches can overlap in how they are implemented. For example:

- Syndromic surveillance can be carried out as part of participatory disease surveillance when communities actively report symptoms.
- Wildlife surveillance often involves active monitoring, but can also include passive reporting from conservation agencies.

Syndromic surveillance

Surveillance based on clinical signs or syndromes rather than confirmed diagnoses.

Application in PPR:

- Detection of pneumo-enteritis syndrome (PES)
- Participatory syndromic surveillance: engaging communities to report cases in real time.
- Recent exercise in Uzbekistan suggests this can provide very timely early detection system, relying on extensive veterinary network and strong links with community.

	Timeliness			
	Group 1	Group 2	Group 3	Group 4
PPR	Immediate **Fast** Moderate Delayed	**Immediate** Fast Moderate Delayed	**Immediate** Fast Moderate Delayed	Immediate Fast **Moderate** Delayed

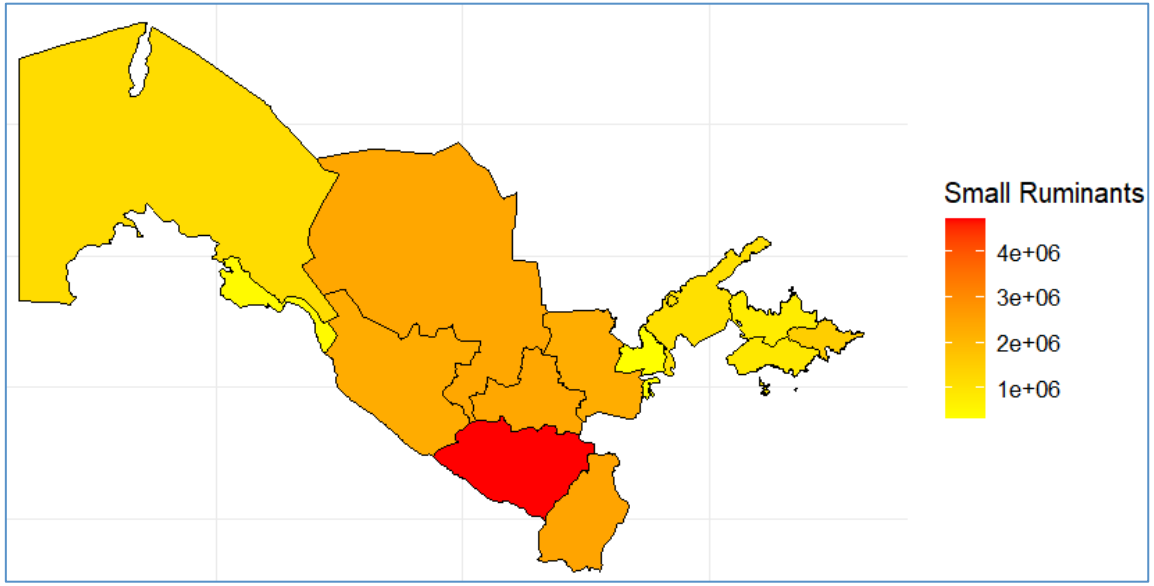
Risk-based surveillance

Proactive collection of data from populations or regions classified as high-risk. (e.g. regions with high animal mobility, such as transhumance routes, areas with history of PPR outbreaks…). Episystem mapping can guide the identification of high-risk “subpopulations”.

Application in PPR:

- Focused surveillance effort in regions or types of flocks considered to be at high-risk making more efficient use of resources.
- Relies on prior risk assessment.

Risk-based sampling vs. random sampling



Small ruminant population by region in Uzbekistan (based on 2022 data from the Uzbekistan statistics agency, www.stat.uz)

Random sampling to ensure representativeness (useful for prevalence estimation)

Risk-based sampling concentrating in areas considered of higher risk (useful for disease detection)

Participatory disease surveillance

Involving communities directly in monitoring and reporting, building on local knowledge for early detection and response.

Application in PPR:

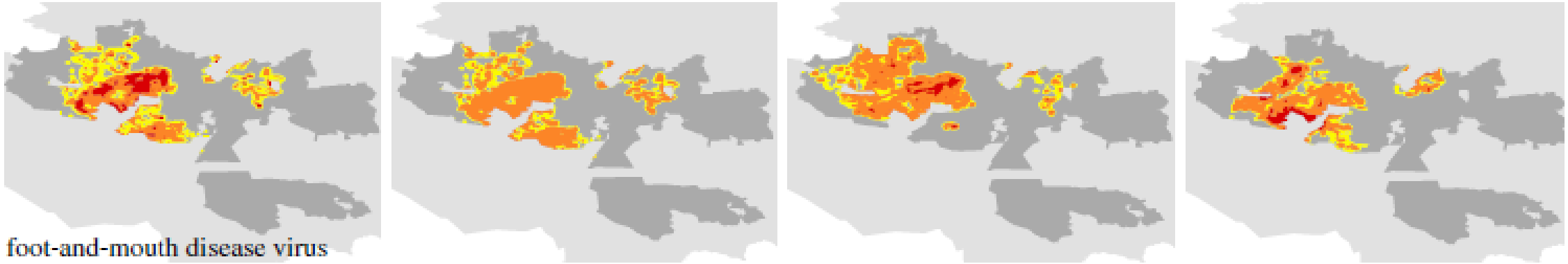
- Improves coverage and sensitivity of surveillance, particularly in remote areas.
- Builds trust and collaboration between veterinary services and communities.

Wildlife disease surveillance

Rapidly assessing the risks of infectious diseases to wildlife species

Wendy Beauvais[1,2], Steffen Zuther[3,4], Chantal Villeneuve[1], Richard Kock[1] and Javier Guitian[1]

Likelihood of saiga been exposed by season.



foot-and-mouth disease virus

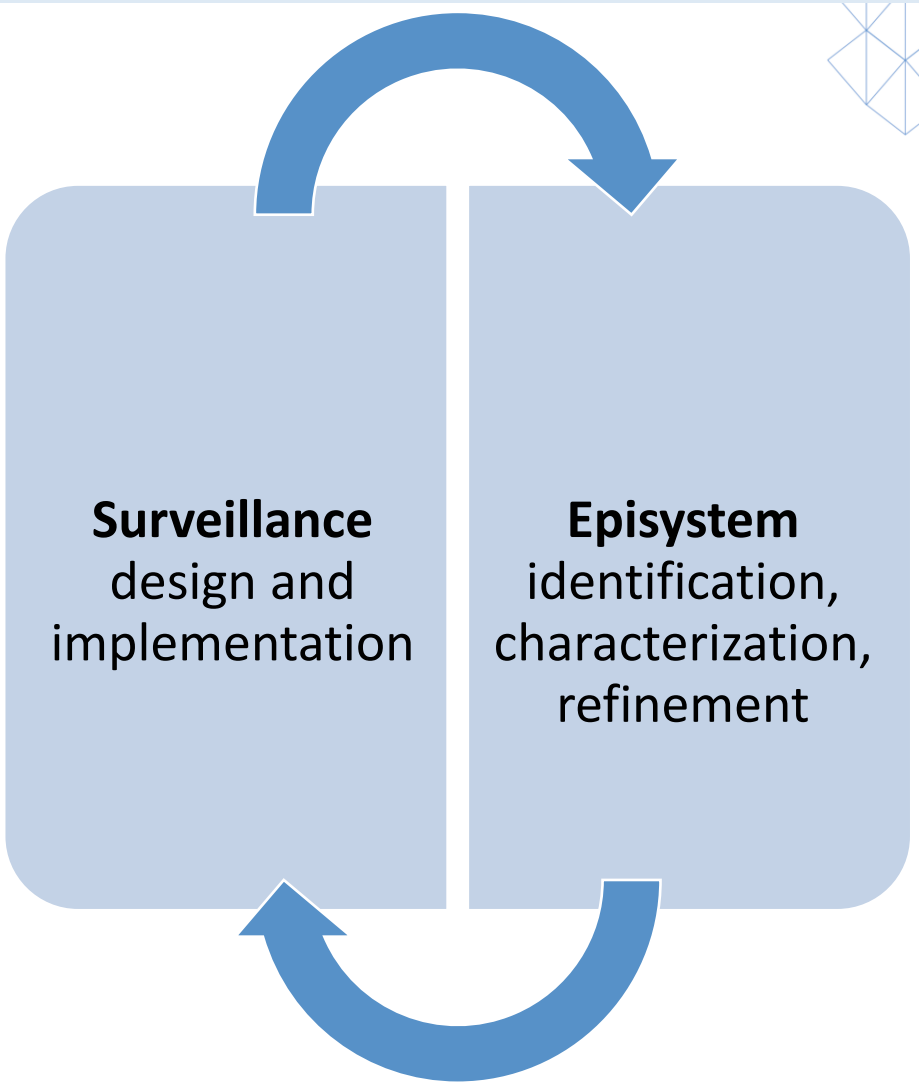
Integrating surveillance and episystems

From Episystems to Surveillance:

- Identifying/characterize episystems to target surveillance.
- Knowledge of connectivity to guide where & how to monitor.

From Surveillance to Episystems:

- Surveillance data:
  - continuously refines episystem characterization.
  - validates assumptions about connectivity & transmission.
  - Example: Identifying unexpected linkages between outbreaks using molecular data.

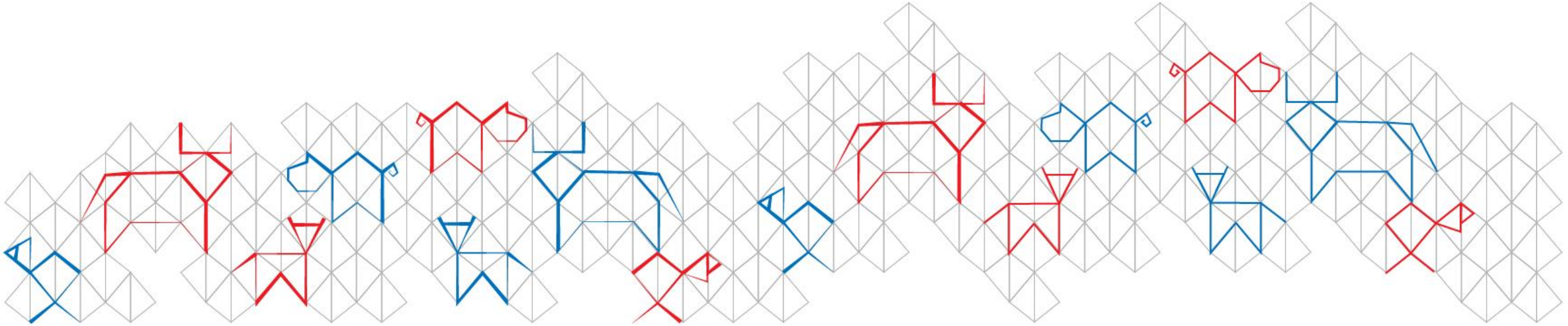


Conclusion

- PPR surveillance and episystem mapping are interlinked and mutually reinforcing.

- Challenges:
  - Data availability and quality.
  - Cross-border coordination.
  - Resource allocation – balancing surveillance activities with resource constraints.

- Recommendations:
  - Start identifying and characterizing episystems based on the “best available data”, do not wait for “the perfect data” – it doesn’t exist.
  - Integrate data streams.
  - Enhance data sharing and work collaboratively.



Thank You