“Are patterns of spatiotemporal clustering of PRRS consistent across years?”

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Key point

- PRRS cases are recognized to be seasonal and aggregated by geographical space.
- However, spatiotemporal patterns of PRRS clustering were not consistent across years
- Drivers of infection spread may vary over the years.

Our approach

A subset of Midwestern MSHMP participants was studied to test whether the space-time clustering patterns of PRRS outbreaks are prominent in any region during a particular period of the year when compared across the years. Data from 358 sow farms belonging to 10 MSHMP participant management systems, from January 2011 through December 2015, were used in the analysis. Each of the ten management systems has at least one farm in Minnesota or within 100 km of Minnesota’s borders.

The space-time permutation scan test of the SaTScanTM software was used to detect space-time clusters. In the space-time permutation, a cylindrical scanning window of varying radius and cylinder height which moves across the study area is used to compare the ratio of the cases and the control locations (Kulldorff and Nagarwalla, 1995). A space-time permutation scan test with a monthly time window and a space window set to include a maximum of 20% of susceptible in a cluster was used for each year separately. Each significant space-time cluster represents the area where the cluster was detected, the time, and the observed to expected ratio (O/E) which stands for the likelihood of the cluster compared to the expected spatial randomness under the null hypothesis. For example, A cluster of PRRS cases with a 20km radius, in February 2012 until May 2012 was detected with a O/E = 3 indicating the area is three times likely to have the PRRS outbreak within that time. To simplify the analysis, detected space-time clusters of PRRS were categorized into two groups based on the time of the year: 1) January-June and 2) July-December.

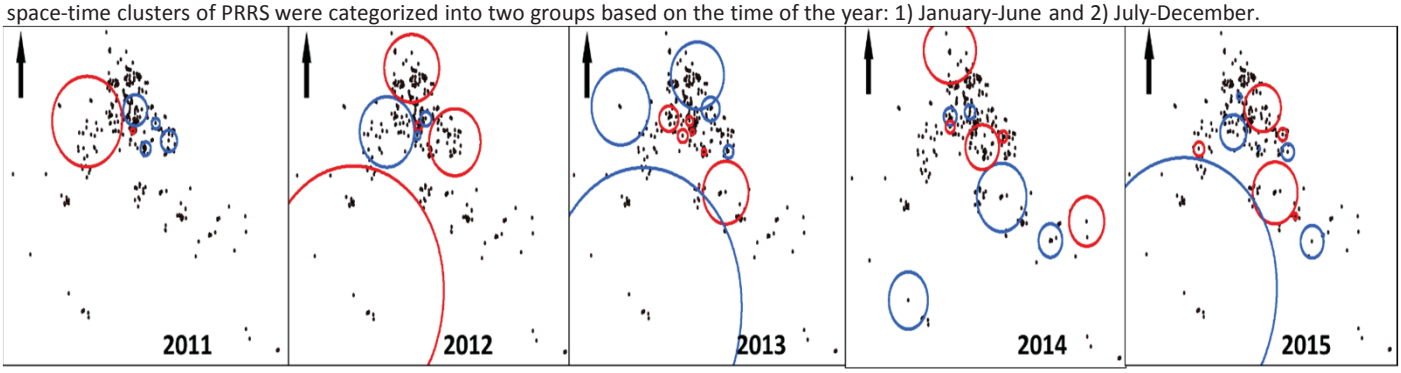

Fig.1. Significant spatial clusters for PRRS in the Midwest are represented by the circles (P-value <0.05). The maximum spatial window size was 20% of the population at risk. The time units were months. The dots represent the farm locations, and the red and blue clusters represent the first and second 6-month period in each year, respectively.

Findings

Significant spatiotemporal clusters were found in the region every year (Fig.1), suggesting that PRRSV is endemic in this area
When compared across years, there was no distinct pattern of space-time clustering in any region, indicating the drivers of infection spread may vary across years.

What does it mean?

The presence of space-time clustering of cases creates the foundation for a statistical model that uses spatiotemporal trends to predict farm-level risks of breaking with PRRS. We hope to analyze the MSHMP data further and understand the drivers of different spatiotemporal clustering patterns. In subsequent versions of the study, new variables such as the immune status of the farm, outbreak status of the neighboring swine farms in the previous week, and pig farm density of the area considered will be incorporated to fit a space-time prediction model of the risk of PRRS outbreaks in sow farms. The model outputs would provide a spatiotemporally explicit
risk score which might help decision makers when improving the current PRRS preventive and control measures.

References

Kulldorff, M., Nagarwalla, N., 1995. Spatial disease clusters and inference. Stat. Med. 14, 799-810.