Predicting the monthly risk of PRRS in Minnesota counties using past MSHMP surveillance data

Kaushi Kanankege(kanan009@umn.edu) , Kimberley VanderWaal, Cesar Corzo, Andres Perez

Key points

- High risk of PRRS occurrence was observed in counties where >25% of MSHMP farms were fully or partially air-filtered, have high number of hog farms, and have farms belonged to multiple production systems.
- PRRS occurrence association with air filters may be due to attempts to mitigate risk in prevalent areas.
- Further research is required to understand the space-time association of the windborne local spread of the virus and the installation of air filters.

Our approach

Data: MSHMP records from May 2013 through April 2017 (48 months), representing 143 sow farms in Minnesota belonging to 8 production systems.

Objective: to estimate the expected number of PRRS-positive farms per month at the county level, while accounting for key epidemiological factors and space-time variation of the PRRS occurrence.

Method: Using the R statistical package CARBayesST[1], Bayesian space-time regression model[2] was fitted.

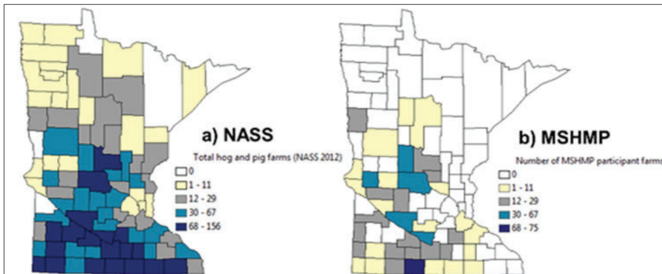

Fig1. Hog farm densities. Panel a) Total of hog farms in Minnesota counties based on National Agricultural Statistical Services (NASS, 2012) and Panel b) The average number of MSHMP monitored sow farms by county.

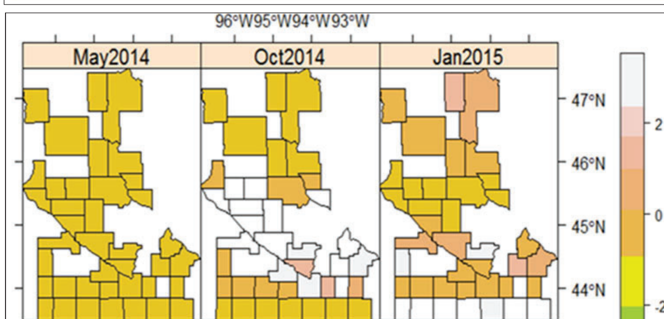

Fig2. Maps showing the changing spatial evolution of the posterior median estimated for PRRS for selected months of candidate years (Logarithmic scale).

Findings

A predictable seasonality of PRRS occurrences was observed with a decline in May-June, the lowest number of outbreaks reported in October, and an increase in November – December (Figure 2-a). The regression results indicated:

1. Counties with >20 total hog farms per county were associated with an increase in the occurrence of PRRS compared to the counties with <20 farms per county.
2. Counties with high PRRS occurrence were also associated with the presence of fully or partially air-filtered sow.
3. Interestingly, even after accounting for farm density, counties with more than one production system were related with an increase in PRRS occurrence relative to the counties where all MSHMP farms belonged to one production system.

What does it mean?

The association of PRRS with swine farm density and presence of farms belonging to multiple production systems within the same county was not surprising, because the higher the swine farm density and the variations of management strategies that are not coordinated across the systems may create opportunities for disease transmission. The association of high PRRS occurrences in farms with >25% with full or partial filtration may be related to the fact that farms with air-filters are located in areas with high farm density as it is the case in southern. Air-filtration was assigned as a variable based on 2018 data, and it is not known exactly when these farms installed the air-filters. Therefore, interpretation of this result should be done cautiously, given that the decision to install air-filters may be based on previous history of outbreaks in those counties. Moreover, the risk of airborne spread of PRRS locally is unmeasured and this result highlights the importance of further understanding the risk of airborne spread.

Conclusions and future directions

Occurrence of PRRS in geographically close farms during the same time (i.e. spatiotemporal autocorrelation) and its relation with underlying epidemiological factors could facilitate the computation of risk scores predicted per county and month. In subsequent versions of the study, models will be validated and the predictive power of the model (i.e. estimation of the risk of PRRS outbreaks in a given county at a given month) will be assessed. The model intends to support veterinarians and managers in decision making when planning preventive interventions against PRRS.

We would really appreciate if you could share your thoughts on risk estimation and management by participating on the survey located at this link https://umn.qualtrics.com/jfe/form/SV_0MSkrAGOz8OPUTX

References

1) Lee, D., Rushworth, A. and Napier, G. 2018. CARBayesST: Spatio-temporal areal unit modeling in R with conditional autoregressive priors using the CARBayesST package. Journal of Statistical Software. 84: 9. doi: 10.18637/jss.v084.i09

2)Rushworth A, Lee D, Sarran C. 2017. An adaptive spatiotemporal smoothing model for estimating trends and step changes in disease risk. Journal of the Royal Statistical Society. Applied Statistics. Series C. 66. Part 1, pp. 141-157

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