When the farm is exposed to a critical level of PRRSv in air, the probability of having an outbreak is four times higher for non-filtered farms: A retrospective analysis using wind data

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Objective:

- To compare the deposition of windborne particles containing PRRSv across the seasons
- To test whether partial or full air filtration of barns could protect against windborne transmission
- To estimate the cost-effectiveness of air filtration

Approach:

We adapted an atmospheric dispersion model (ADM) named Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT)[1] to simulate windborne dispersion of porcine reproductive and respiratory syndrome virus (PRRSv) between swine farms in a near real-time manner using National Oceanic and Atmospheric Administration (NOAA) wind data. The risk of airborne introduction of PRRSv was estimated semi-quantitatively based on the cumulative daily deposition of particles over 14-day period from known outbreak farm (i.e. emitting farms). In this retrospective study, we used 4-years of MSHMP data (2014 – 2018) from Minnesota, pertaining to 167 farms. While the filtration status of some farms changed over time, the analysis included filtered (n=49), partial (n=15), not filtered (n=56), and unknown (n=47) farms. The parameters used in the HYSPLIT models were published in our recent work[2]. The parameters included epidemiological features of PRRSv, characteristics of aerosolized particles, and survival of aerosolized virus in relation to key meteorological /features. To compare the deposition of airborne particles containing PRRSv across the seasons, particles emitted from outbreak farms were measured in the modeling platform at every 24th hour. Then, the cumulative 14-day deposition on a farm was summarized by four seasons. Farms that received a critical level of PRRSv containing particles above the assigned thresholds for each season were considered as potentially at high-risk farms[2]. Farms with unknown filtration status were excluded from the comparison, and the transmission was considered primarily due to windborne transmission.

Results and Discussion:

When the farm is not exposed to a critical level of PRRSv in air (as defined by the threshold), the probability of having an outbreak is the same regardless of filtration status (0.61 vs. 0.63%; Figure 1). This is likely due to several factors including outbreaks caused by movements, or re-emergence of the virus in an infected farm. When the farm is exposed to a critical level of PRRSv in the air, the probability of having an outbreak is almost 4 times higher for non-filtered farms (3.7/0.96 = 3.85; red circled in Figure 1). When data were analyzed without accounting for real-time risk of windborne route of the pathogen, the observation often leads to the conclusion that filtered farms are often associated with outbreaks. However, when accounted for windborne exposure, as predicted by the model, it shows the protective effect of filters. While further studies are needed to tease apart windborne and other routes of transmission, including animal and personnel movements, we encourage to consider this observation and compare with the cost-effectiveness of barn air filtration which estimated to ranges $1.50 – 2.40 vs. cost of a PRRS break $6 – 8 per weaned pig (i.e. Return on investment is 4:1)[3, 4].

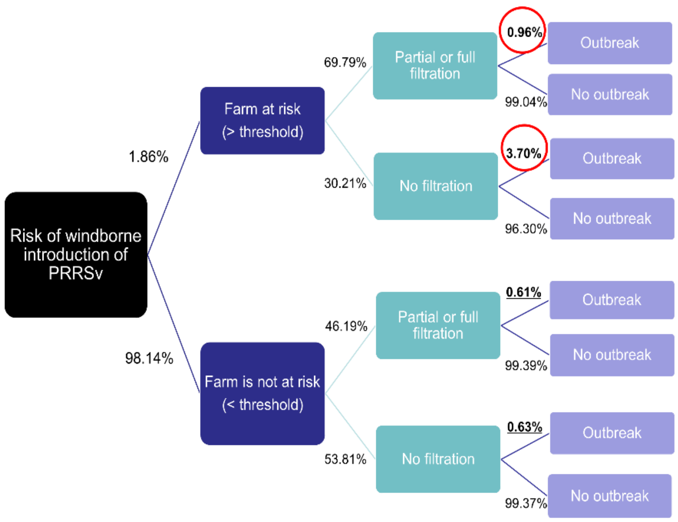

Figure 1. Decision tree analysis comparing the farms at risk, outbreaks, and barn filtration. Farms receiving windborne aerosol depositions above threshold were considered to be 'at risk'.

Take home:

Within the data limitations, our simulations of four-year long wind data suggested that when a farm is exposed to a critical level of PRRSv in air, the probability of having an outbreak is four times higher for non-filtered farms compared to those with full or partial air filtration.

References

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