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SDEC Partners Research Update

Project Update: Implications of Management Interventions on a Model of Influenza A Virus Persistence within Swine Breeding Herds

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Background

- Influenza A virus (IAV) is a global endemic infection in swine that causes significant morbidity and poses a substantial public health risk.
- Swine serve as an important "mixing vessel" for the reassortment of IAV strains. There have been documented cases of swine-to-human and human-to-swine transmission.
- Recent modelling and empirical work on influenza A virus (IAV) indicate that piglets play an important role as an endemic reservoir.

Objective

To test intervention strategies that producers could employ to reduce the incidence of IAV in piglets in swine breeding herds.

Approach

- We developed a theoretical disease model to simulate the spread of IAV within a standard swine breeding herd. This model accounts for both the production class (sows, gilts, and piglets) and immune status of every animal in the herd.

- Using this model, we tested a variety of biosecurity and management interventions including: (1) varied timing of gilt introductions to the breeding herd, (2) gilt isolation (no indirect transmission to or from the gilt development unit), (3) gilt vaccination upon arrival to the farm, (4) early weaning, and (5) vaccination strategies of sows with different timing (mass and pre-farrow) and efficacy (homologous vs. heterologous).

Conclusions

- In concert, mass vaccination, early weaning of piglets (removal 0-7 days after birth), gilt isolation, gilt vaccination, and longer periods between introductions of gilts (6 months) were the most effective at reducing prevalence (Figure 1). Using this combination strategy, endemic prevalence overall was reduced by 51% relative to not doing anything; endemic prevalence in piglets was reduced by 74%; and IAV was eliminated completely from the herd in 23% of all simulations (Figure 2).
- The incubation period, infectious period, duration of immunity, and transmission rate for piglets with maternal immunity had the highest correlation with three separate measures of IAV prevalence. Therefore, these parameters warrant further empirical study.

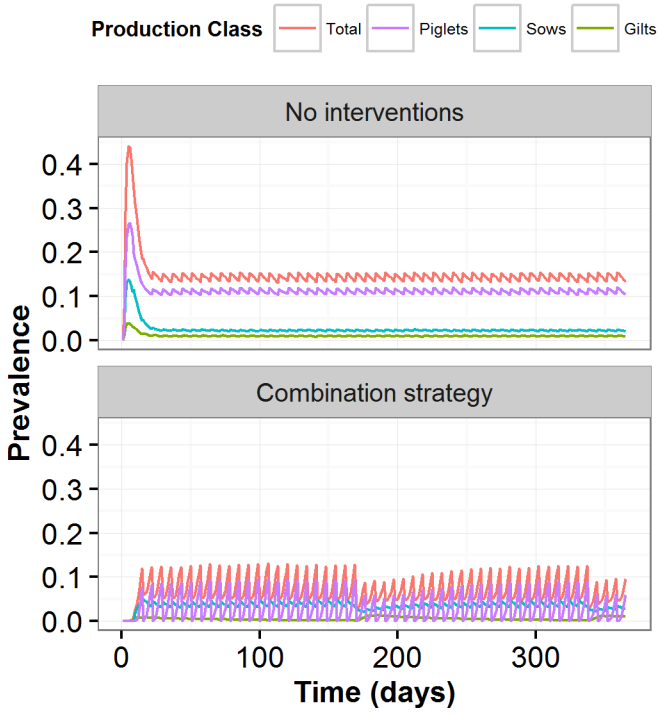

Figure 1. Predicted prevalence of IAV in a breeding herd simulated for one year. Shown for the cases of no interventions and a combination of biosecurity and vaccination strategies using mean or expected parameter values from the literature. Mean prevalence of infected piglets, sows, and gilts relative to the total prevalence of infected pigs in the herd are shown—piglets experience the brunt of infection after the initial outbreak.

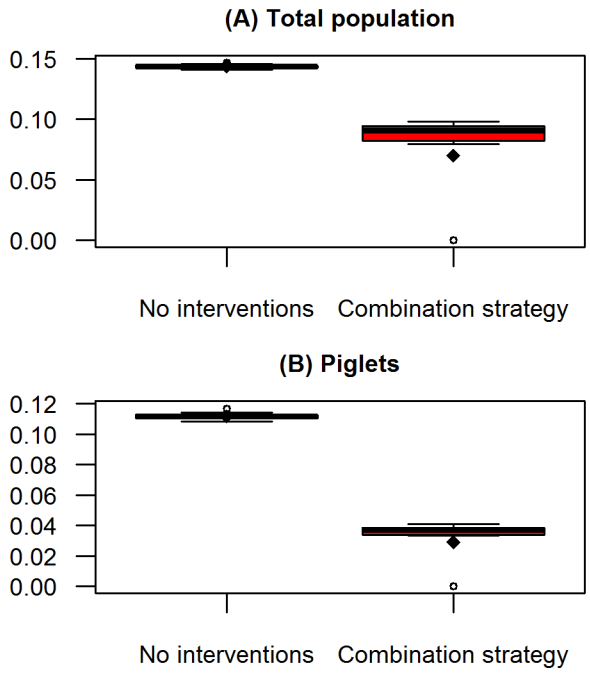

Figure 2. Box and whisker plots showing: (A) the endemic prevalence of IAV in the total population and **(B)** the endemic prevalence of IAV in piglets (i) without any interventions and (ii) with a combination of vaccination and biosecurity interventions implemented. For each plot, the median, the first (25%) and third quartiles (75%), and the minimum and maximum values observed are shown.

Final summary

⇒ Our findings support other modeling and empirical studies that suggest that piglets play a key role in maintaining IAV in breeding herds.

⇒ We recommend a combination of biosecurity measures in conjunction with targeted homologous vaccination or vaccines that provide wider cross-protective immunity to prevent introductions of virus to the farm and subsequent establishment of an infected piglet reservoir.

⇒ The model presented here is a tool to test intervention strategies and helps address knowledge gaps where data is not available.