“Effective disease surveillance and response strategies depend on detailed swine shipment data”

Amy Kinsley, DVM; Meggan Craft, PhD; Andres Perez, DVM, PhD, Kimberly VanderWaal, PhD

Key Point:

- A production system’s vulnerability to disease spread can be greatly reduced when selectively identifying a subset of farms as disease control targets.

What did we do? In this study, we used a network approach to describe annual movement patterns between swine farms in three multi-site production systems (1,063 farms) in the United States. We measured:

1) degree (Figure 1) – number of farms to which a farm ships or receives pigs
2) farm’s individual contribution to disease spread via its movements
3) mean infection potential (MIP), which measures potential incoming and outgoing infection chains (Figure 1)

The connectivity of swine movement networks influences a system’s vulnerability to disease spread (measured as R_0, or the number of secondary farms infected from a single primary case). Here, we asked, “Can we reduce the production system’s vulnerability to disease spread through targeting specific farms for disease control?” To test this, we “removed” farms from the network based on their connectivity (solid lines in Figure 2) or randomly (dashed lines in Figure 2) and measured the change in R_0. Removing a farm is the model’s equivalent of a disease control method such as vaccine use.

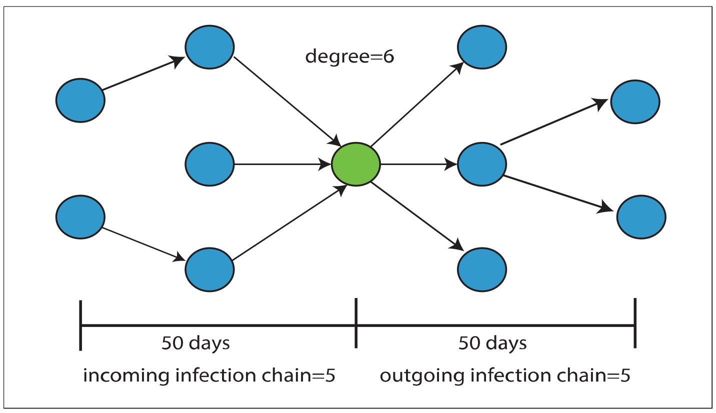

Figure 1.The circles represent farms and the lines represent movement of pigs. The incoming and outgoing infection chains are the number of farms that send pigs to the farm of interest, including the indirect contacts considering the order of the movements. The infection potential is a function of the incoming and outgoing infection chains. The degree of a farm equals the number of other farms it is connected to by pig movement. The green farm has a degree of 6 because it is connected to 6 other farms

What we found:

- Removing farms based on their mean infection potential substantially reduced the potential for transmission of an infectious pathogen through the network when compared to removing farms at random, as shown by a reduction in the magnitude of R_0 attributable to contact pattern.
- The MIP was more efficient at identifying targets for disease control compared to degree and farm’s contribution to disease spread.

What does this mean?

By targeting disease interventions towards farms based on their *mean infection potential*, we can substantially reduce the potential for transmission of an infectious pathogen in the contact network, and performed consistently well across production systems.

Fine-scale temporal movement data is important and is necessary for in-depth understanding of the contact structure in developing more efficient disease

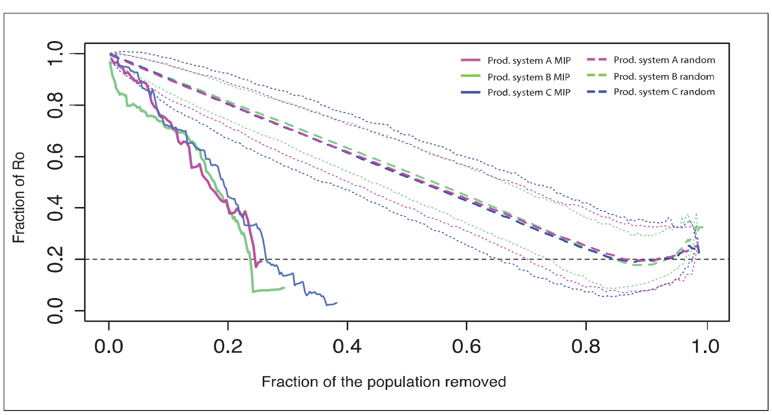

Figure 2. Reduction in the magnitude of R_0 with removal of farms prioritizing those with the highest mean infection potential (solid lines) or removing farms in a random order (dashed lines). The dotted lines represent the 2.5th and 97.5th percentiles. The horizontal dashed line corresponds to an 80% reduction of the magnitude of R_0.

Find other MSHMP Science Pages at
https://z.umn.edu/SciencePages

5/4/2018