STØTTET AF
Svineafgiftsfonden

Unmasking PRRS infections: Lessons from Danish modelling

As is well-known, Denmark is well on the way to free the country from Porcine Reproductive and Respiratory Syndrome (PRRS) virus. This is obviously easier said than done. Several lessons can be drawn from Denmark's approach, but one thing is clear: measuring data and transparency are key.

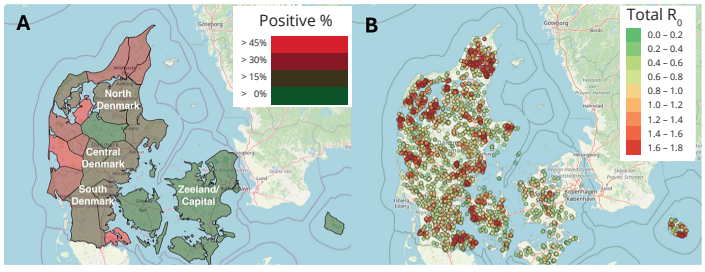
BY DR YOU CHANG, UNIVERSITY OF COPENHAGEN, DENMARK; AND OTHERS*

Porcine Reproductive and Respiratory Syndrome (PRRS) has been challenging the Danish pig industry for more than three decades. Even with the Specific Pathogen Free (SPF) system in place, the virus continues to circulate among the Danish pig population, resulting in productivity losses and higher costs. The 2024 reduction plan has reduced herd prevalence from 35% to 22%. Still, many farmers ask the same questions: where does PRRS spread the most? Which farms pose the highest risk? And what are the effective control measures?

To help answer those questions, the University of Copenhagen, in collaboration with SEGES Innovation and the Danish Agriculture & Food Council, has developed a nationwide model to understand how PRRS spreads between pig herds in Denmark. Using data from more than 3,400 herds, the team mapped how PRRS spreads from farm to farm, identified undetected so-called "hidden infections", and tested a range of control strategies.

The results, published in 2025 in the peer-reviewed journal *Preventive Veterinary Medicine*, reveal both hope and challenge: while Denmark's control programme can reduce herd prevalence, hidden infections still play a major role in the spread of the disease, and more frequent testing, coordinated action, and stricter trading rules are essential to fully eradicate PRRS.

Figure 1 - Maps of the PRRS-situation in Denmark. Map 1A shows the observed PRRS prevalence. Map 1B shows the estimation of how many herds an infected farm would infect if all farms are PRRS-free, expressed in R_0.



Movement and local spread

PRRS spreads between farms in more than one way. Pig movements and local spread both play important and different roles in transmission. With infrequent testing, many infections remain undetected, allowing the virus to keep circulating.

Pig movements can spread PRRS over long distances and introduce the virus into regions that were previously virus-free. A single risky movement from an undetected infected herd can start a new outbreak. Local spread, on the other hand, is what causes PRRS to persist and to amplify in high-density areas. The farms included in the study have an average of 11 neighbouring farms within a 5 km radius, creating many opportunities for the transmission of PRRS, such as through airborne spread, shared equipment and personnel, or indirect contact.

Where are the PRRS hotspots?

Local spread explains why some farms consistently struggle with PRRS. The research team calculated a between-herd reproduction number (R_0) for every herd. In simple terms: how many herds one infected herd could infect if all other herds are PRRS-free.

Figures 1A and *1B* (R_0 map) clearly show the highest risk areas for:

- North Denmark;
- Central Denmark, especially along the western coast;
- Parts of South Denmark.

Those areas identified matched the observed PRRS infection patterns seen by farmers and veterinarians, and aligned with the observations from surveillance data (comparing *Figures 1A* and *1B*). In these "hotspots," PRRS can keep spreading even if farmers avoid high-risk pig movements, precisely because of local spread.

Early outbreaks: real superspreaders

Not all PRRS-infected herds spread the virus equally. They can be grouped as follows:

- Highly infectious herds (early outbreak herds)
  These herds shed a lot of viruses and are usually not reported as detected early on. This happens usually during the first 90 days after the introduction of PRRS.
- Lowly infectious herds
  These herds shed the virus at lower levels. They have not been detected as positive.
- Detected positive herds
  These herds are detected and identified as PRRS-positive by the surveillance system, through blood tests or clinical signs. Most control measures, such as movement or depopulation and repopulation, only target detected herds.

When looking at surveillance data, the team estimated that both a herd in the early outbreak phase and highly infectious herds can infect neighbouring farms roughly 50 times more than a lowly infectious herd. During that period, herds shed large amounts of the virus and often still remain undetected, which makes them both risky and hard to control.

The findings show that, although only 17% of infectious herds went undetected, those undetected herds were responsible for roughly 60% of all PRRS transmission. This highlights why more frequent detection is important for reducing hidden infections and preventing PRRS from spreading further.

More frequent testing pays off

Increasing blood testing from once a year to twice a year can reduce herd prevalence, but monthly testing was found to be even more effective, driving prevalence down to just 2-3% of herds, within several years (see *Figure 2*). At first, monthly testing caused an apparent rise in detected positives, but that was simply the system "catching" previously hidden cases. More frequent testing reveals hidden infections and numbers may climb before they drop.

Depopulation-repopulation – emptying, disinfecting and restocking a herd with PRRS-free pigs – produced the quickest visible decline in infection. Depop-repop reduced the observed prevalence by up to 20% within two years. However, the long-term impact of depop-repop is restricted by infrequent testing due to the undetected infections.

The study confirms that risk-based trading – buying pigs only from the same PRRS-infection status herds – remains one of the simplest and most effective mitigation measures. Increasing trading compliance from 80% to 100% could reduce overall PRRS prevalence by about one third.

Still, even perfect compliance cannot prevent infections from undetected positive farms. That is why a combination of risk-based trading, more frequent testing, and depop-repop in hotspot regions achieved the best outcome, bringing the national R_0 below 1 and moving Denmark toward eradication.

Coordinated local action is key

PRRS does not stop at the farm gate. The R_0 maps show clusters where neighbouring herds share high risk, highlighting the need for regional cooperation. When farmers coordinate, the benefits multiply: if one farm improves its status, nearby

PRRS virus is able to spread from farm to farm, which is why it is necessary to have a good overview of Denmark's pig farms in relation to where infections are happening. Photo: Mark Pasveer

Frequent blood testing is essential to reduce herd prevalence. The tubes on the picture were not photographed in Denmark. Photo: **Koos Groenewold**

farms are also protected. That is the strength of region-based control. Local networks – veterinarians, advisors and producer groups – can use the maps to plan coordinated elimination campaigns in high-risk zones.

What this means for producers

For farmers and veterinarians, the message is clear:

- Find infections early: Test regularly.
- Don't trade blindly: Only buy pigs from confirmed PRRS-free herds.
- Keep improving biosecurity: Pay attention to clean trucks, visitors, and equipment.
- Collaborate locally: Work with nearby herds to control infection pressure together.

Eradication may sound ambitious, but the Danish model shows it is achievable though a consistent, collaborative, and targeted effort.

Looking ahead

The study provides the first national PRRS transmission model in Denmark and a data-driven guide for the control strategy ahead.

Hidden infections remain the biggest challenge, but tools such as frequent testing, coordinated depopulation-repopulation, and strict trading rules can tip the balance. PRRS will not disappear overnight – but with the right combination of surveillance, biosecurity, and collaboration, it is possible to achieve eradication.

** Apart from the primary author, a range of other experts contributed to this article, i.e. Ana Rita Pinheiro Marques, Mette Fertner, Nils Toft, Bjørn Lorenzen, Mossa Merhi Reimert, Hans Houe and Beate Conrady. They are connected to the University of Copenhagen, SEGES Innovation and the Danish Agriculture & Food Council.*

Figure 2 – The predicted impact of different control measures.