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Pathogen control within the pyramidal structured network of pigs' movements in France

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INTRODUCTION

Animals purchases = major route of pathogen transmission
Better understanding of animal movements → better assessment of control measure impact

Objective: Modelling approach to assess the effect of control measure on *Salmonella* and on Reproductive and Respiratory Syndrome (PRRS) spread at between-herds level in pork production chain

MATERIALS & METHODS

Data from volunteers during 12 months:

- 4 herds in Selection level
- 25 herds in Multiplication level
- 300 herds in Production level

Four types of herds:

- 210 farrow-to-finish,
- 16 breeding,
- 10 post-weaning finisher,
- 143 finisher herds.

6673 movements:

- 3157 herd-to-herd,
- 3516 to slaughterhouses

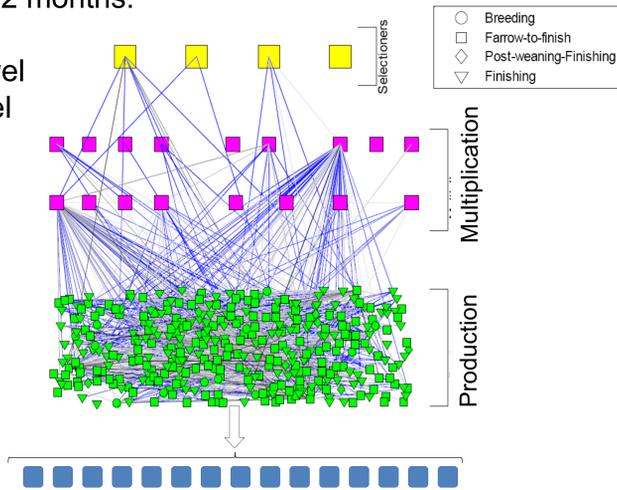


Fig 1. Representation of the French pork food chain network

Five categories of animals moved: 8-kg piglets (5.2%), 25-kg piglets (5.5%), reproductive gilts (36.6%), finishing pigs (43.3%) and culled sows (9.3%).

Using recorded data, a network model is built with probability of movements occurrence between herds (Fig. 1).

Measures to test :

- Two sub-networks: 'restricted' versus 'unrestricted'
- Restriction of animals movements according to herds health status of suppliers
- Reduction of within-herd transmission

PRRS

In 'Restricted' sub-network, infected herds are supplied by only non-infected herds.

Salmonella

Classification according to the contamination level: Danish control plan

In 'Restricted' sub-network: herds supplying only by herds with contamination level lower or equal to its own level



RESULTS

The total number of connected herds at the end of the simulation differs drastically according to the category of animals considered (Fig. 2). Simulation results highlight importance of gilts in between-herds contacts.

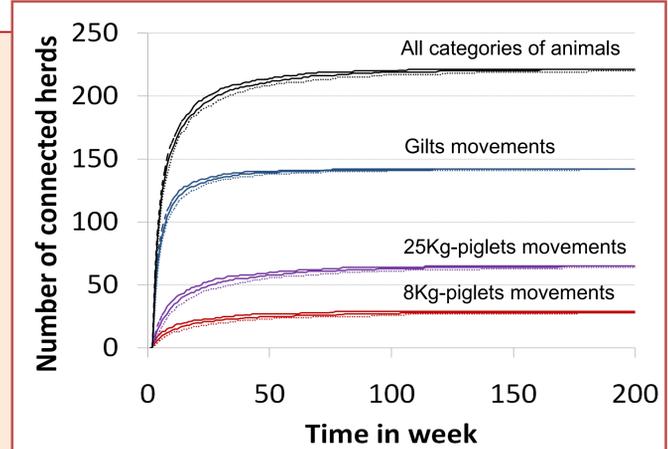
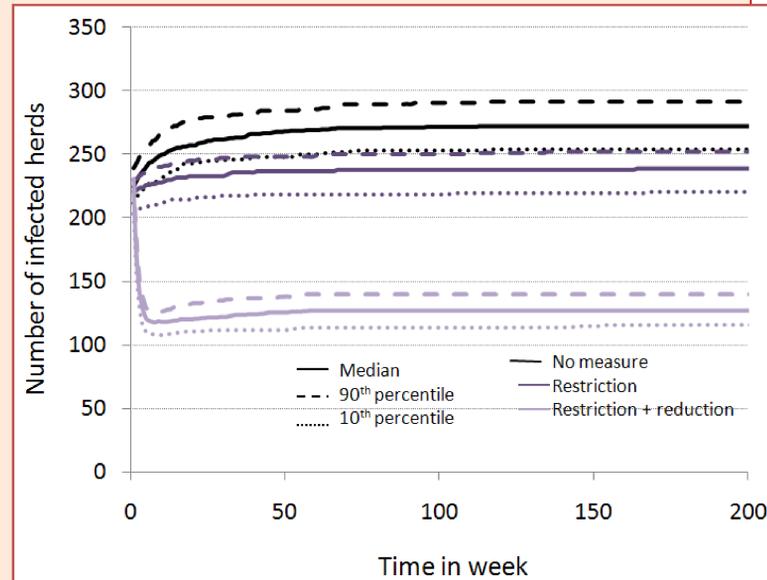


Fig 2. Median number of herds infected during a theoretical epidemic over 200 weeks considering all categories of animals' movements or only one category (8-kg weighted piglets, 25-kg weighted piglets, reproductive gilts)

Fig 3. Number of herds infected by the Porcine Reproductive and Respiratory Syndrome over 520 weeks, with 60% of the herds of the Production structure initially infected (reduction corresponds to 50%-reduction of the within-herd virus persistence)



PRRS infection → decrease in the number of infected herds (Fig. 3):

- when purchase of animals is restricted in the half of the pyramid: 238.5 herds instead of 273 herds;
- restriction combined with a 50%-reduction of the within-herd virus persistence leads to 181 infected herds.

Salmonella spread (Fig. 4): only combination of restriction and within-herd transmission reduction induces a drastic reduction in the number of highly contaminated herds (Cont 2 and Cont 3).

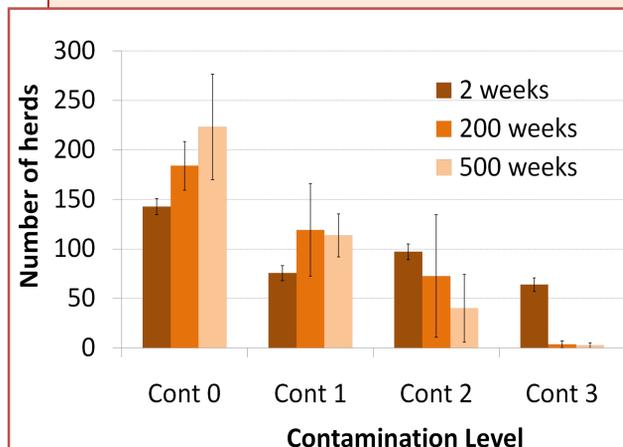


Fig 4. Distribution of herds according to their level of contamination (Cont 0, Cont 1, Cont 2 and Cont 3) based on the Danish plan characterisation at 2 weeks, 200 weeks and 520 weeks of simulation. The measure control applied combined both the restriction of animals' movements and action aiming at reducing the infection in herds belonging to the 'clean' sub-network.

DISCUSSION

Our model allows to assess the effects of combinations of control measures at several scales.

Simulated results show that according to the type of pathogen controlled, the effect of the same measure implementation can lead to different consequences.