

Transmission dynamics and impact of influenza A virus in pigs

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Outline

Enzootic infections vs epizootic infections:

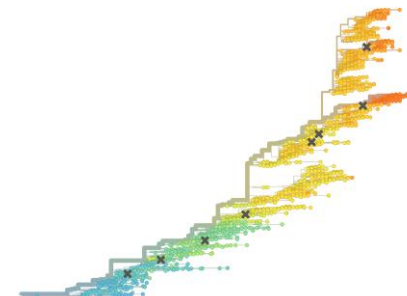
- Transmission dynamics
 - Age groups involved
 - Shedding patterns
 - Level of protection obtained by antibodies
 - MDAs
 - Impacts
 - Clinical signs

➤ Study 1 and Study 2

Enzootic infection over one year

- The role of the sows
- Genetic variability

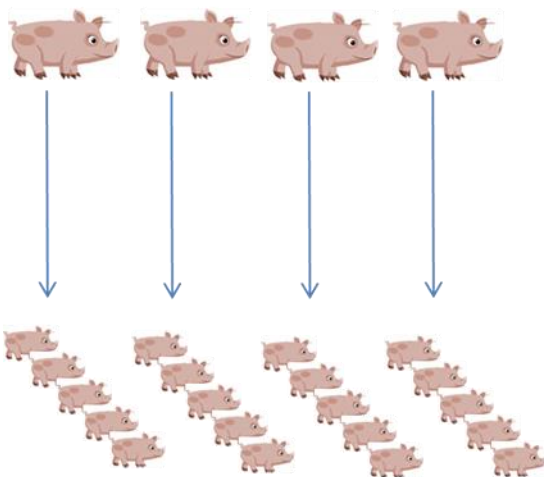
➤ Study 3








Study 1 – study design



4 batches of:



-  2 weeks before farrowing
-  1 week after farrowing
-  Week 3 and week 10-12
-  Week 1, 3, 5 and week 10-12
-  Week 1, 3, 5 and week 10-12

Ryt-Hansen et al. *Vet Res* (2019) 50:36
<https://doi.org/10.1186/s13567-019-0655-x>



RESEARCH ARTICLE

Open Access

Longitudinal field studies reveal early infection and persistence of influenza A virus in piglets despite the presence of maternally derived antibodies

Pia Ryt-Hansen^{1*}, Inge Larsen¹, Charlotte Sonne Kristensen¹, Jesper Schak Krog¹, Silke Wacheck² and Lars Erik Larsen¹



In total per herd:
 16 sows and 80 piglets sampled over ~4,5 month

Study 1 - results

HERD 1

HERD 2

HERD 3

2 weeks before farrowing (AB):

2 weeks before farrowing (AB):

2 weeks before farrowing (AB):



week 1



week 1



week 1



week 3



week 3



week 3



week 5



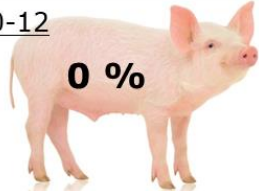
98 % of the infected pigs were infected between week 1 and week 5



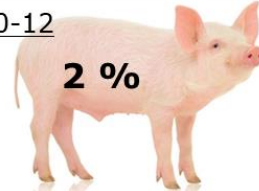
week 5



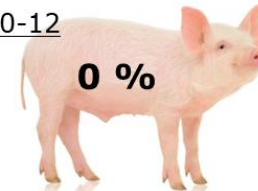
week 10-12



week 10-12



week 10-12



swIAV prevalence

Study 1 - results

HERD 1

1 week after farrowing (virus)



HERD 2

1 week after farrowing (virus)



HERD 3

1 week after farrowing (virus)



Study 1 - results

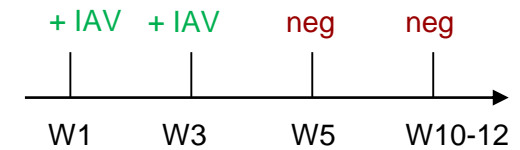
Viral shedding

Consecutive shedding - "Prolonged shedders"

Herd 1: 2 pigs

Herd 2: 1 pig

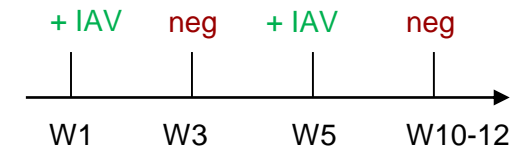
Herd 3: 11 pigs



Non-consecutive shedding – "re-infections"

Herd 1: 1 pig

Herd 3: 13 pigs



Study 1 - results

Coughing index (CI)

$$CI = \frac{\text{no. of coughs and sneezes}}{\text{no. of pigs in the pen} \times 3 \text{ min}}$$

- Correlation in Herd 1

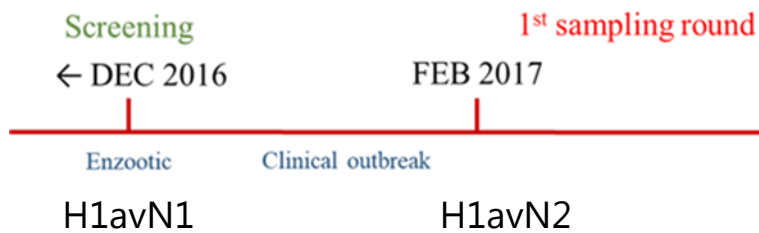


Nasal discharge

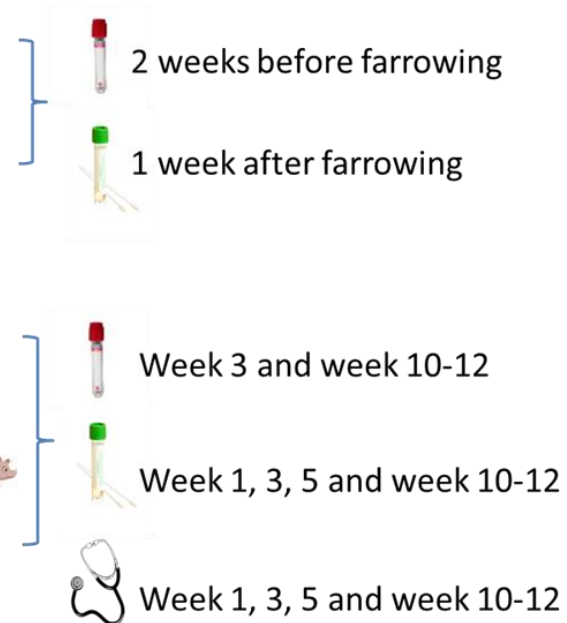
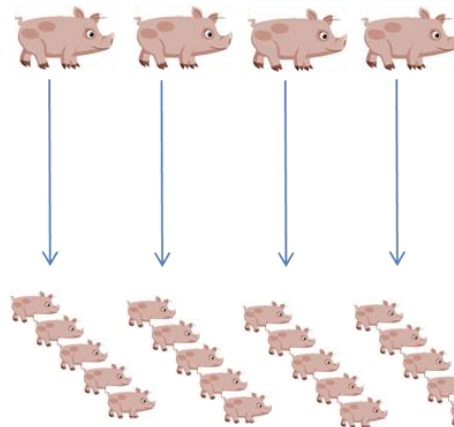
- Correlation in Herd 2
- Overall correlation in all tree herds



Study 2 – study design



4 batches of:



RESEARCH ARTICLE

Acute Influenza A virus outbreak in an enzootic infected sow herd: Impact on viral dynamics, genetic and antigenic variability and effect of maternally derived antibodies and vaccination

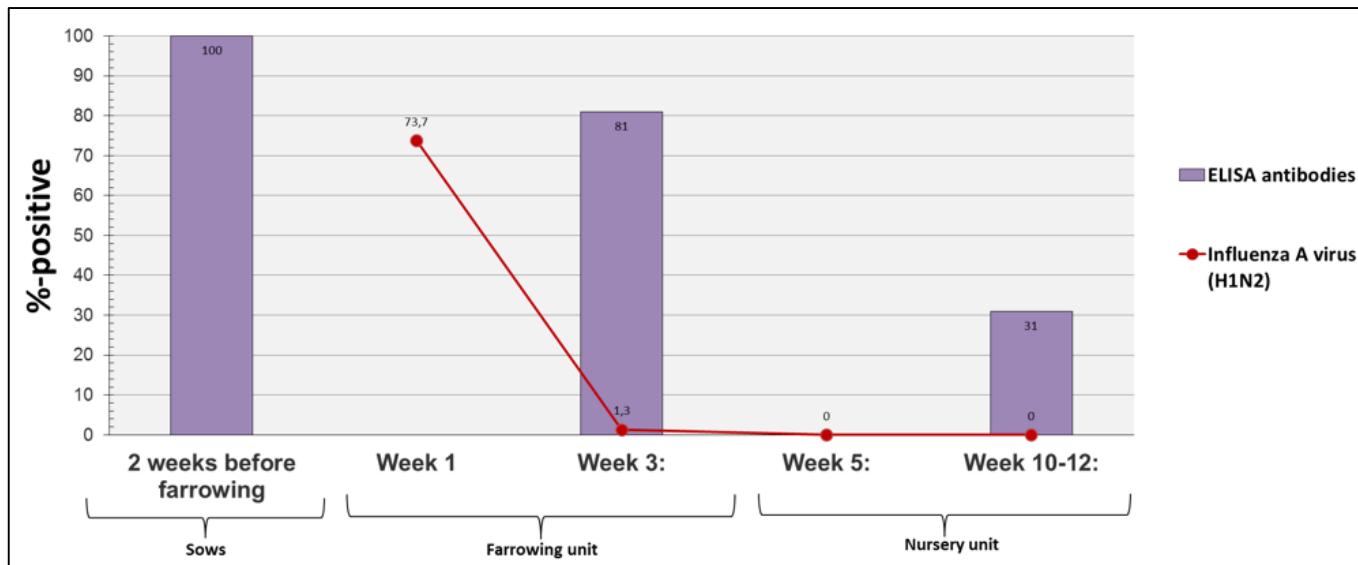
Pia Ryt-Hansen^{1*}, Anders Gorm Pedersen², Inge Larsen³, Jesper Schak Krog¹, Charlotte Sonne Kristensen¹, Lars Erik Larsen^{1,3}

1 National Veterinary Institute, Technical University of Denmark, Kongens Lyngby, Denmark, 2 Department of Health Technology, Section for Bioinformatics, Technical University of Denmark, Kongens Lyngby, Denmark, 3 University of Copenhagen, Dpt. of Veterinary and Animal Sciences, Frederiksberg C, Denmark, 4 SEGES, Danish Pig Research Centre, Aarhus N, Denmark



Study 2 – results

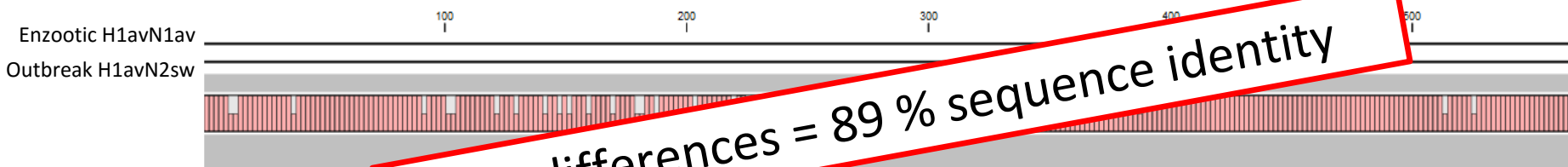
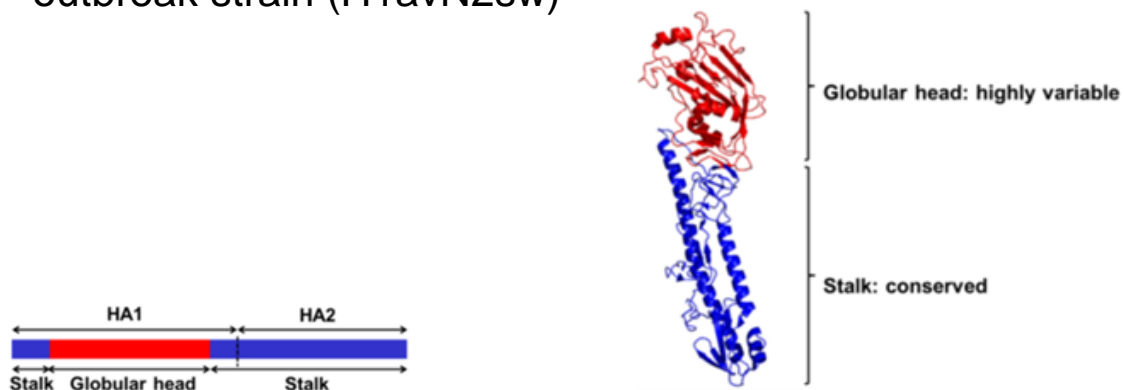
1st sampling round - outbreak with H1avN2sw



- HI-test:
 - 100 % of the sows had antibodies towards the old H1avN1
 - 40 % of the sows had antibodies towards the outbreak H1avN2sw
- Impaired level of cross-reactive antibodies within the same lineage

Study 2 - results

HA sequence identity between the enzootic strain (H1avN1av) and the outbreak strain (H1avN2sw)



60 AA differences = 89 % sequence identity

HA1 = globular domain

Study 3 – study design

Herd 3

- 480 sows
- Weekly batches
- No IAV vaccination
- IAV circulating in the farrowing unit and in the nursery

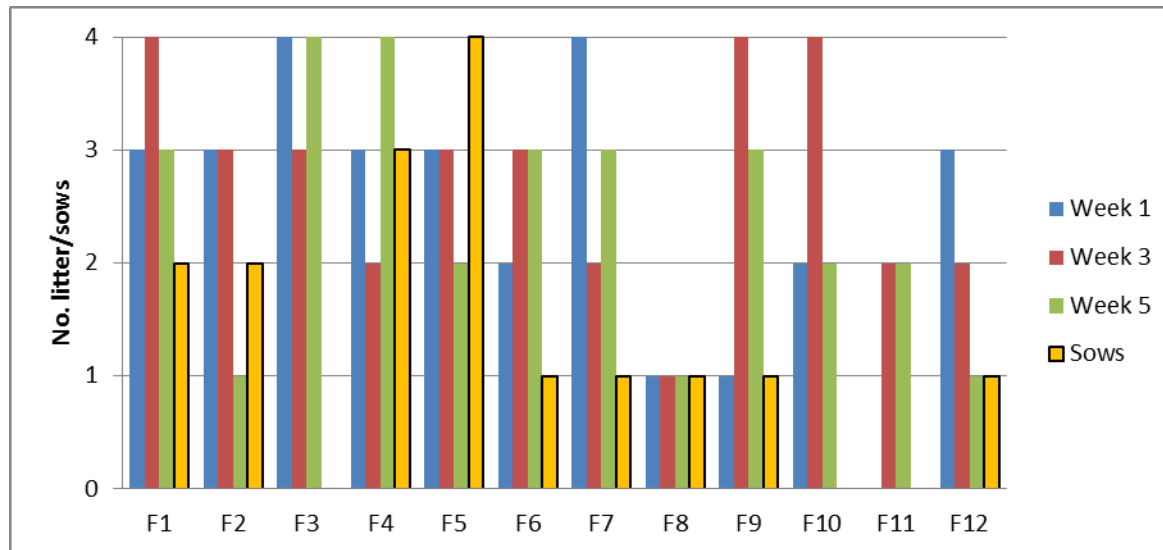
Sampling

- Monthly nasal swabs (cross-sectional)
 - 20 from four one-week-old litters
 - 20 from four three-week-old litters
 - 20 from four pens with five-weeks-old pigs
 - Four from the sows of the one-week-old litters
- Coughing index from all sampled litters and pens



Study 3 - results

November 2017 – October 2018



- 60-70 % of all litters/pens positive
- 33 % of sows (88 % also had a positive litter)
 - 1st parity sows

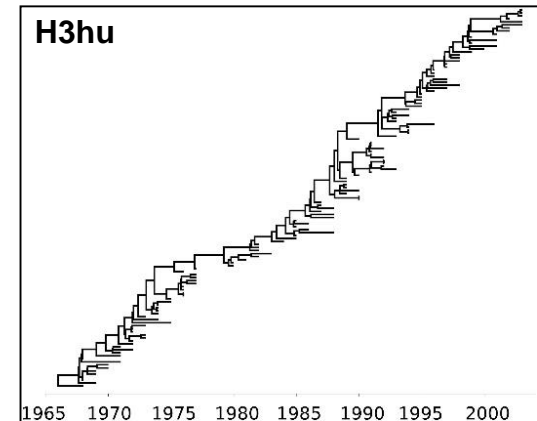
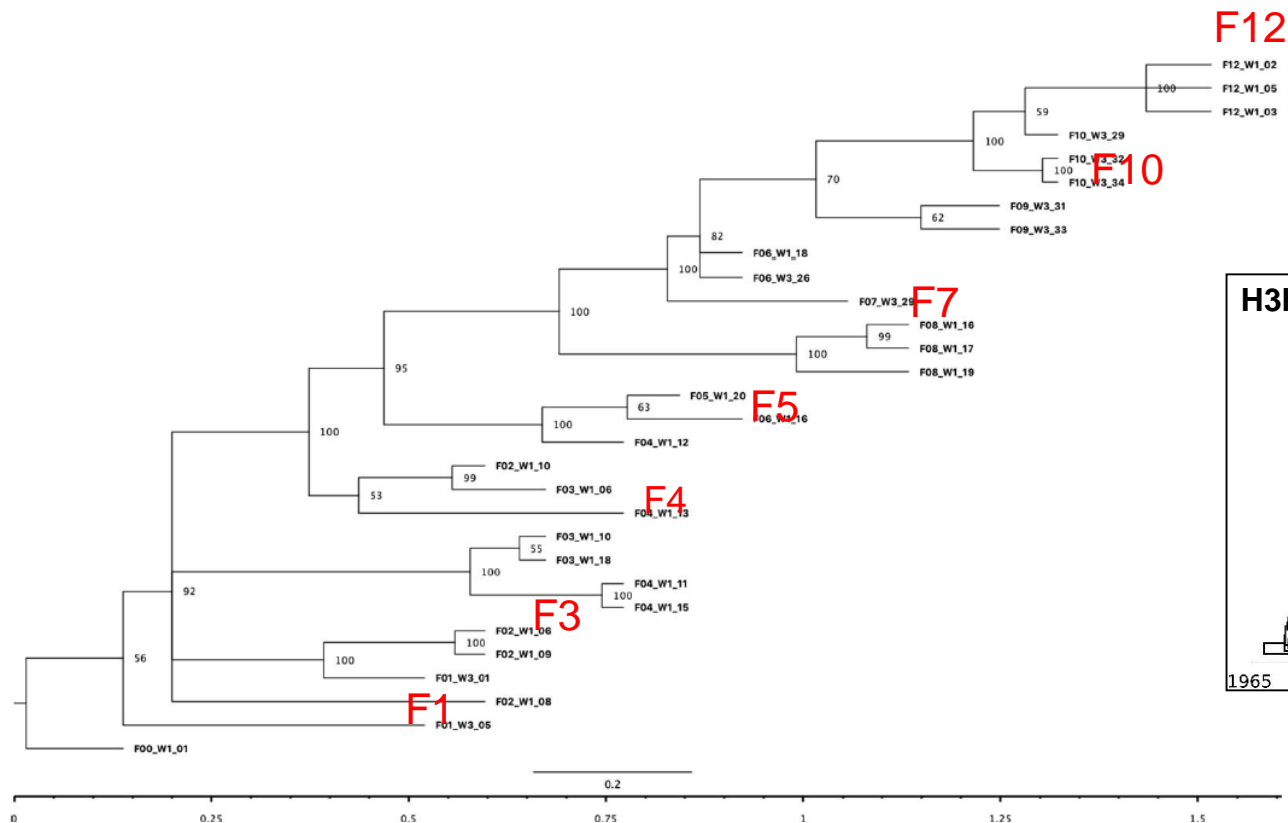
Coughing index:

- Significant correlation between positive litter and an increased coughing index



Study 3 - results

HA sequences (F0-F12):



Discussion and conclusions

- **Enzootic infected herds:**
 - IAV infections from day 3
 - MDAs do not protect against virus shedding
 - Extended shedding time
 - Re-infections
 - MDA wane
 - Genetic drift = antigenic drift (similar to humans)
 - Sows/gilts are part of the transmission dynamics
 - Infection piglets \longleftrightarrow sows/gilts
- **Epizootic infected herd:**
 - Cross protective antibodies cannot be expected within the same subtype
 - Early infections
- **Clinical impact:**
 - Correlated with upper respiratory infections

Acknowledgements

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Herds

- Anonymous

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Thank you for your attention

- Questions?

