

Farm biosecurity measures
associated with delivering

hepatitis E virus

negative batches of pigs
to slaughter

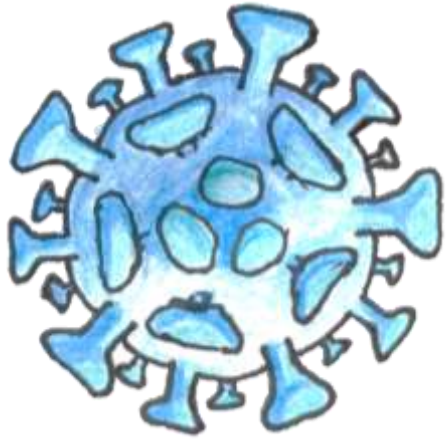
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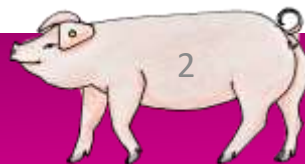
Introduction

Hepatitis E virus (HEV)



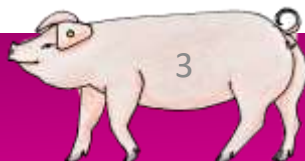
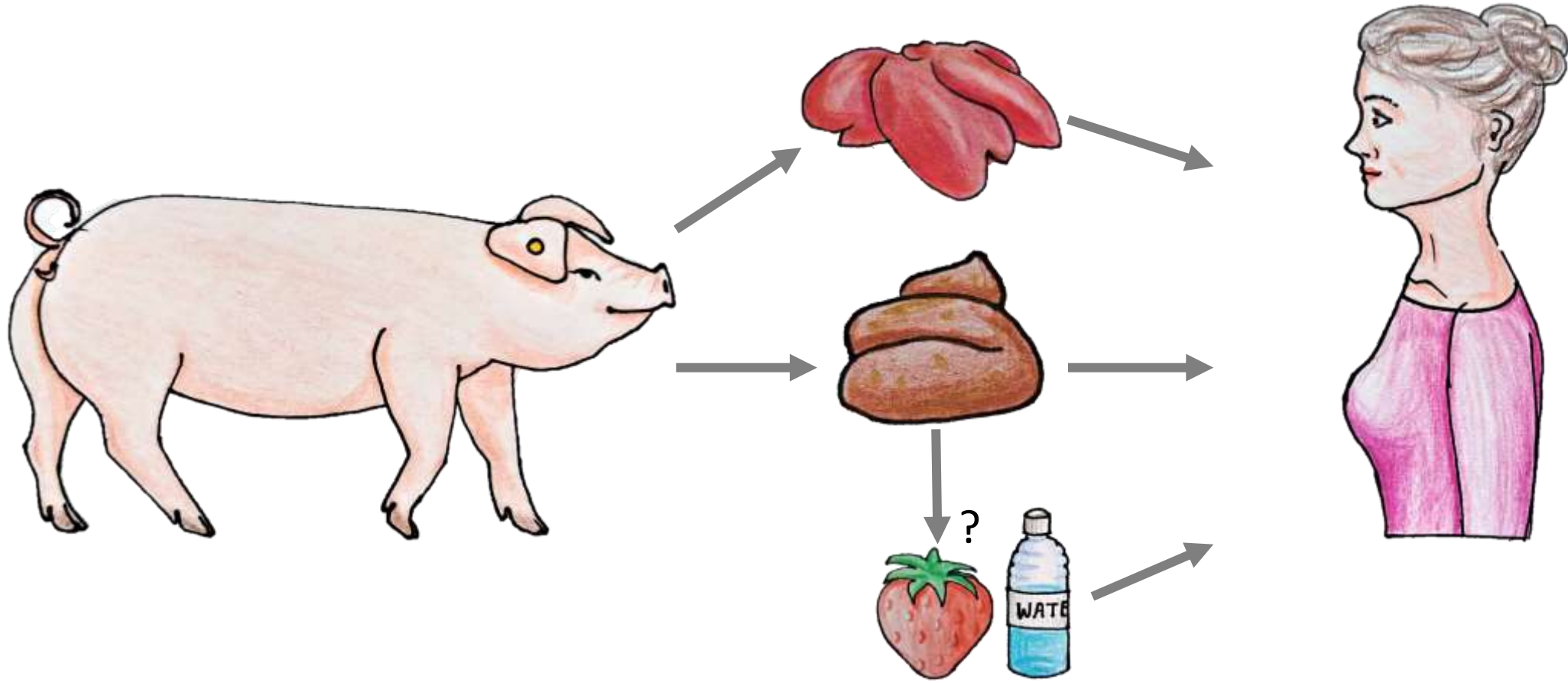
- Quasi-enveloped ssRNA virus
- Genotypes 1 to 4 can infect humans

- Incubation: 3-8 weeks
- Acute self-limiting infection, often asymptomatic
- Jaundice; Fever; Malaise; Vomiting; Hepatomegaly



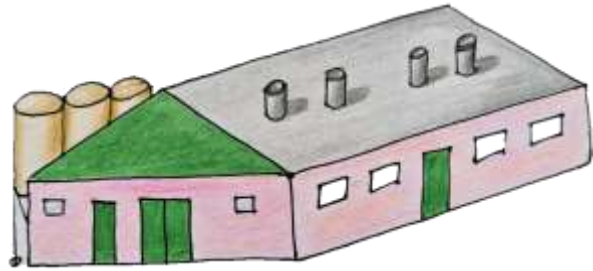
Introduction

HEV transmission - pig to human



Methods

HEV prevalence study

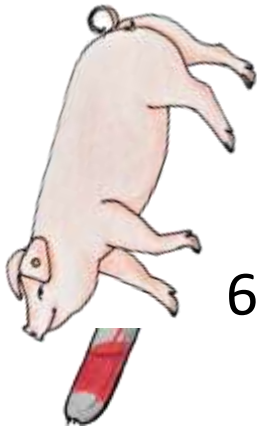


215 pig farms



January to August 2019

8 batches / farm

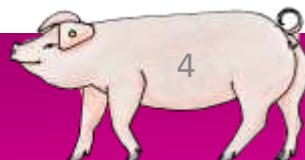


6 samples / batch

10.600 serum samples

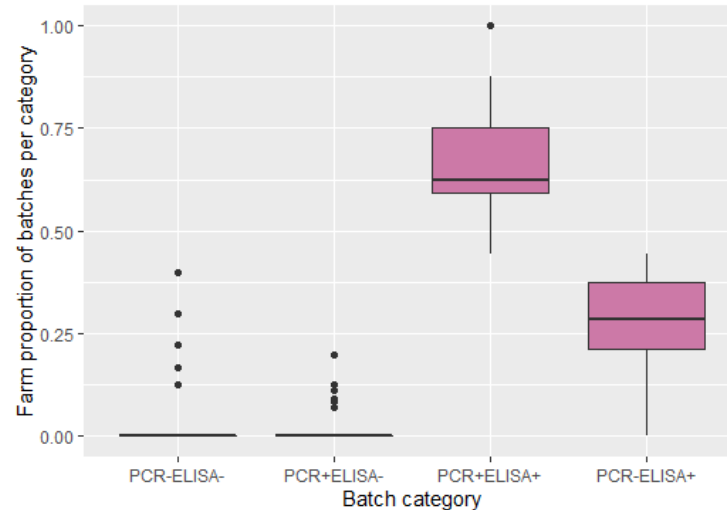
Individual antibody ELISA

Pooled PCR per batch

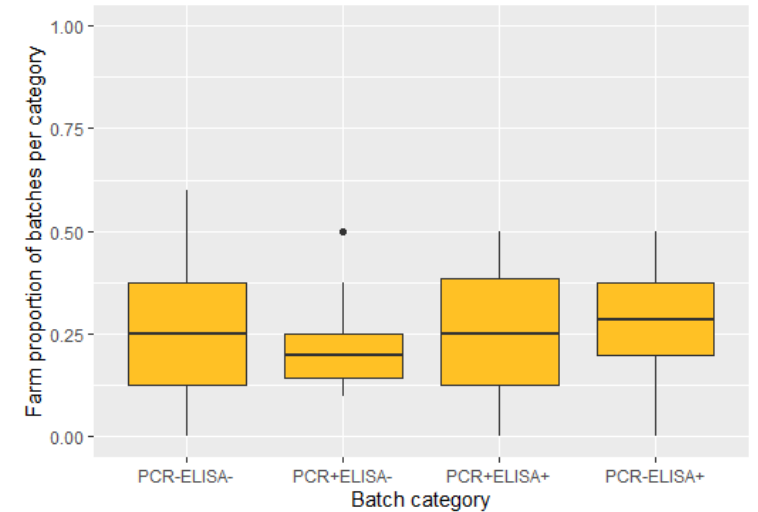


HEV prevalence study

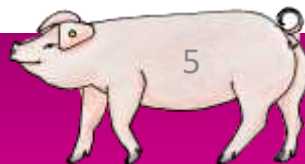
- All farms > 15% of pigs at slaughter seropositive (Mean 74%, 67 – 87%)
- On average 40% of batches PCR positive
- But, what about batches within farms?



- Cluster 3 farms:
 - Batches are both PCR and ELISA positive
 - Other batches are only ELISA positive
- Early infection, sometimes re-infection?
 → Or continuous circulation?



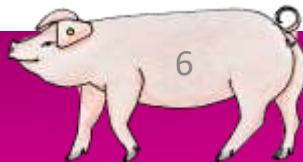
- Cluster 4 farms:
 - Batches in all 4 categories
 - ¼ is PCR and ELISA negative
- Prevention of HEV transmission to some groups
 → PCR+ELISA- batches suggest late infection



Research Question

Which farm biosecurity measures are associated with the delivery of HEV PCR-ELISA- batches to slaughter?

i.e. are related with a low within-farm transmission of HEV?



methods

Farm selection case-control study

215 pig farms in prevalence study

High within-farm transmission
N=76

Low within-farm transmission
N=67

73 pig farms participated
N=38

Grouped logistic regression:
The odds of having a batch that is PCR and ELISA negative

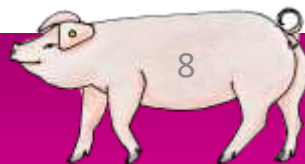


Methods

Farm biosecurity data collection

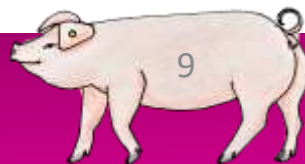
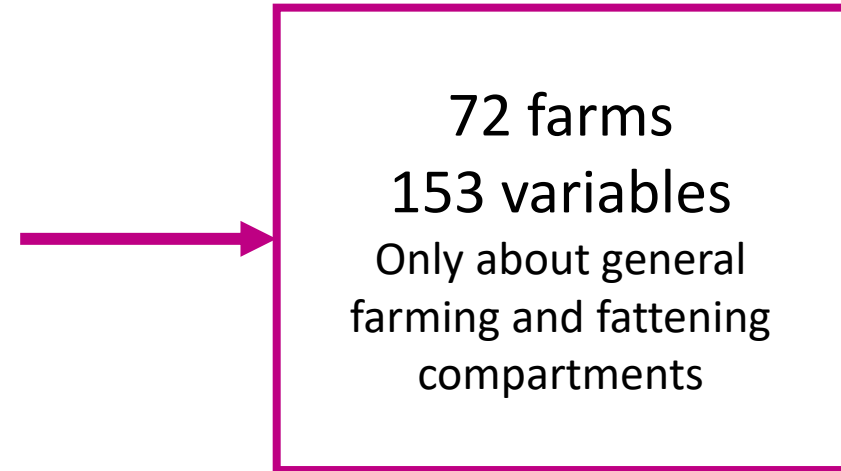


- Questionnaire & audit
- 280 questions
- Themes: Cleaning & disinfection – Rodent control – Transmission between farm compartments etc.
- About 2019 (batch prevalence data)
- Blind for HEV results



Data cleaning

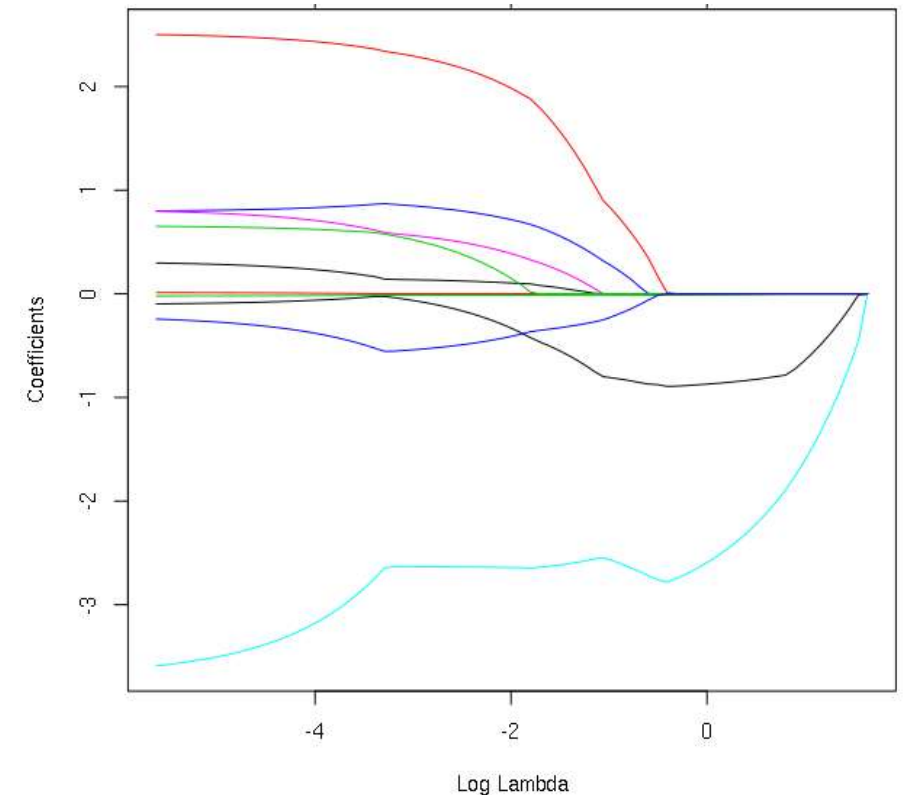
- Variables without variation
- Non-interpretable questions
- Impossible answers
- Questions with >15% NAs
- Combine binary questions to categorical
- Subsets for different farm types
- Multiple imputation by chained equations



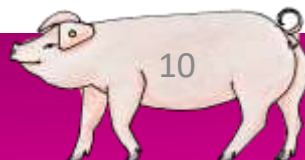
grouped logistic LASSO regression

- Multivariable model
- Shrinks all coefficients a certain amount, dependent on λ
- Why?
 - More variables than observation units
 - Multicollinear variables
- λ : Best value is determined by cross-validation

- Bootstrap sampling with nested λ determination, for stability analysis

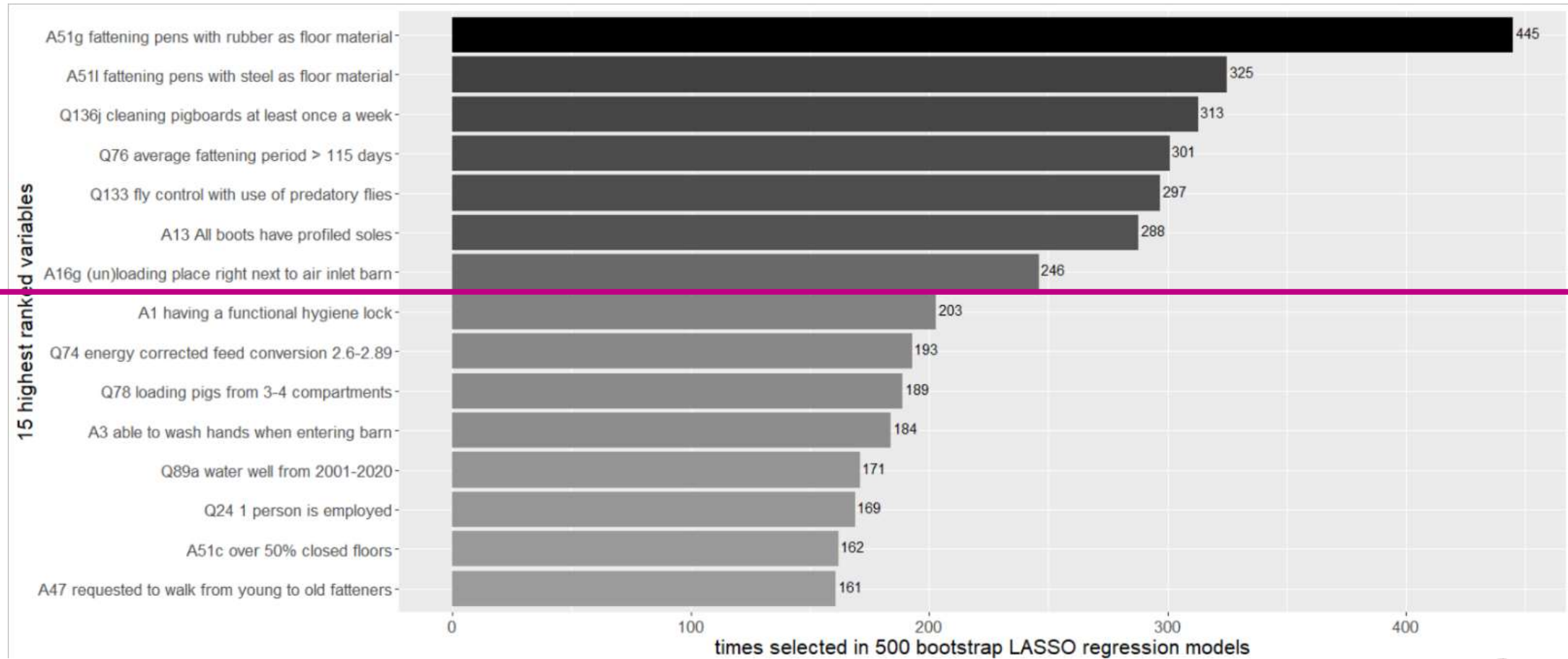


Tibshirani et al. 1996, Journal of the Royal Statistical Society



Results

Selected variables and stability



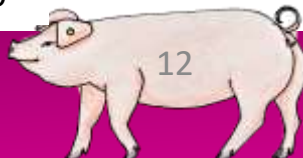
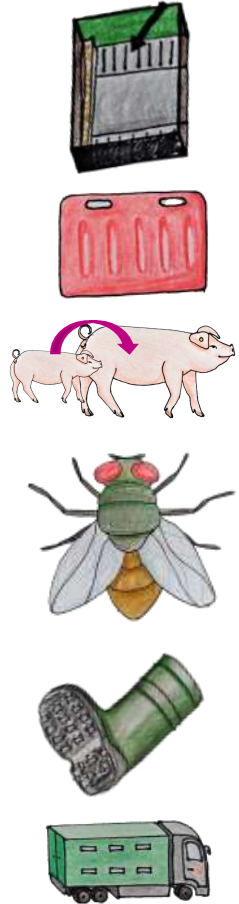
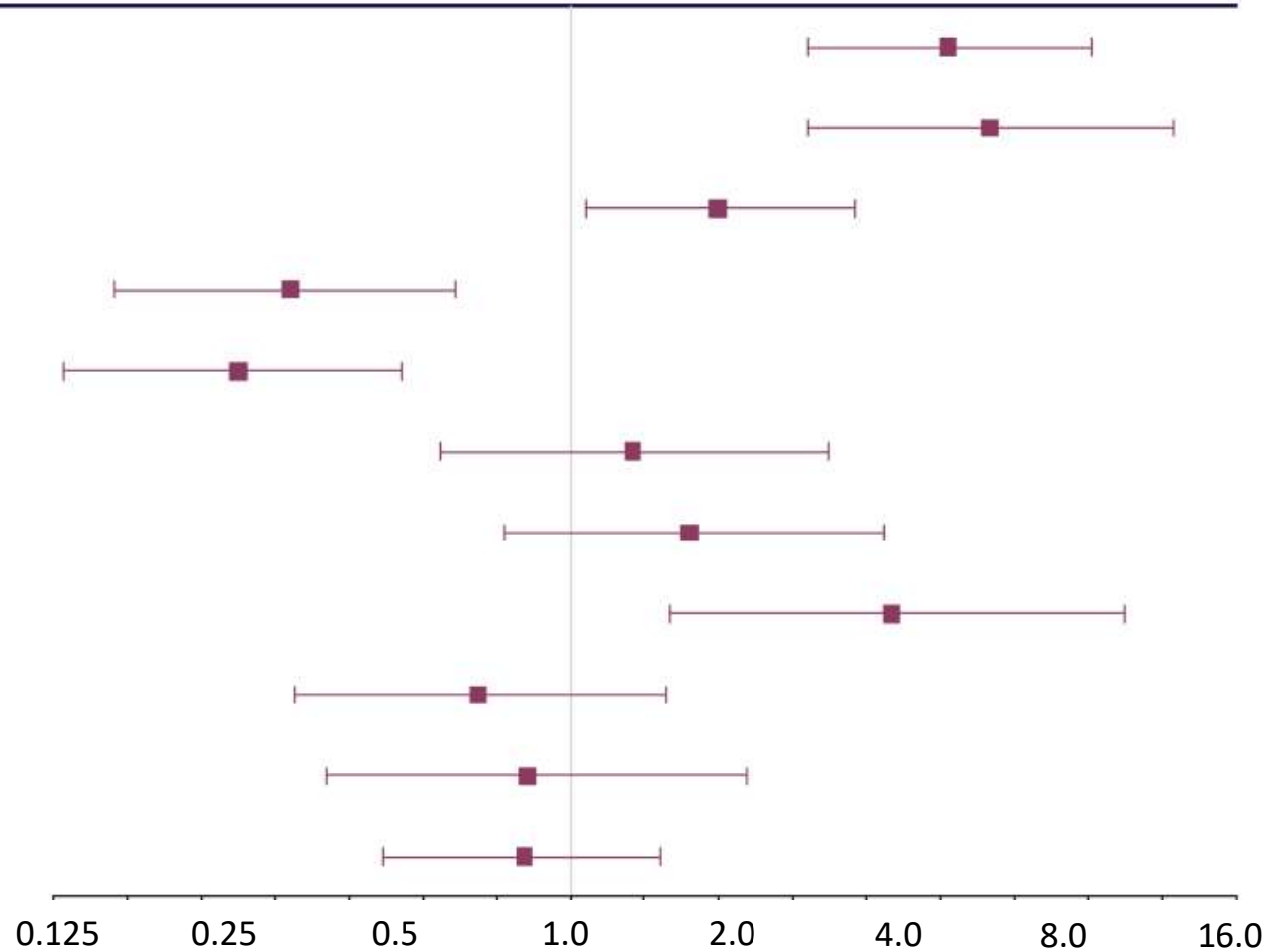
Results

Final grouped logistic regression model

Variable **OR**

The odds of having an HEV PCR-ELISA- batch

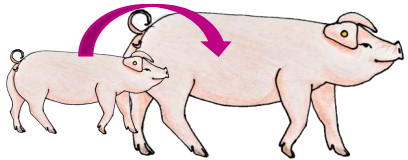
Rubber floor material fatteners	5.87
Steel floor material fatteners	7.13
Cleaning pig boards every week	1.99
Average fattening period 105 to 115 days	0.27
Average fattening period > 115 days	0.21
Fly control with pesticides on walls	1.34
Fly control with pesticides in pit	1.75
Fly control by predatory flies	4.51
Part of boots with profiled sole	0.66
All boots with profiled sole	0.81
Unloading place next to air inlet	0.80





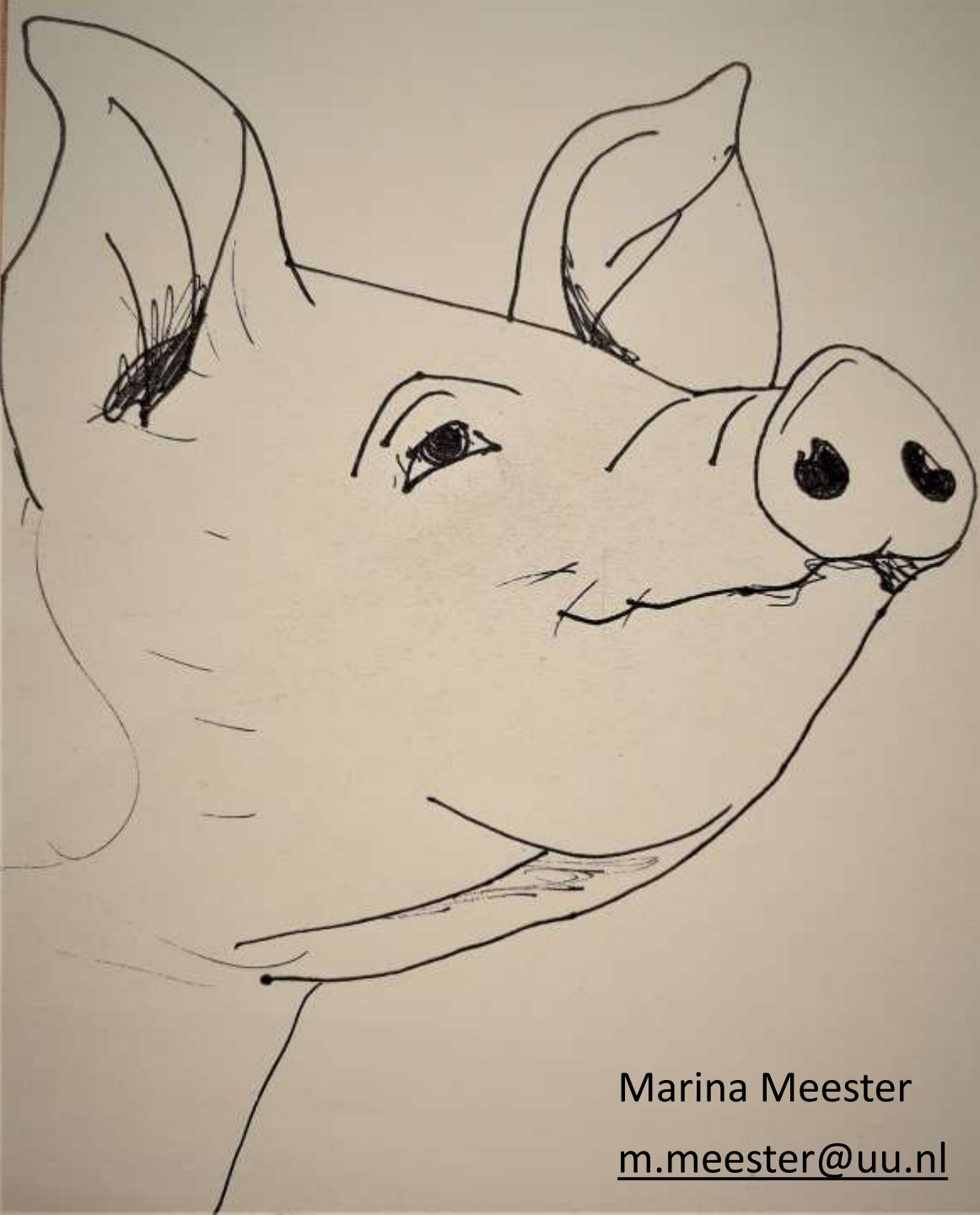
Discussion

- Other risk factor studies
 - Age at slaughter¹
 - Other pig viruses: Mechanical transport by flies^{2,3}
- External biosecurity
 - Sanitary Ford^{4,5}
 - Quarantine¹
 - Contact with other species⁴
- Biases with questionnaire data



1: Walachowski et al. 2014, Epidemiology and Infection; 2: Blunt et al. 2011, Veterinary Microbiology; 3: Otake et al. 2004, The Veterinary Record; 4: Lopez-Lopez et al. 2018, Veterinary Microbiology; 5: Wilhelm et al. 2016, Canadian journal of veterinary research





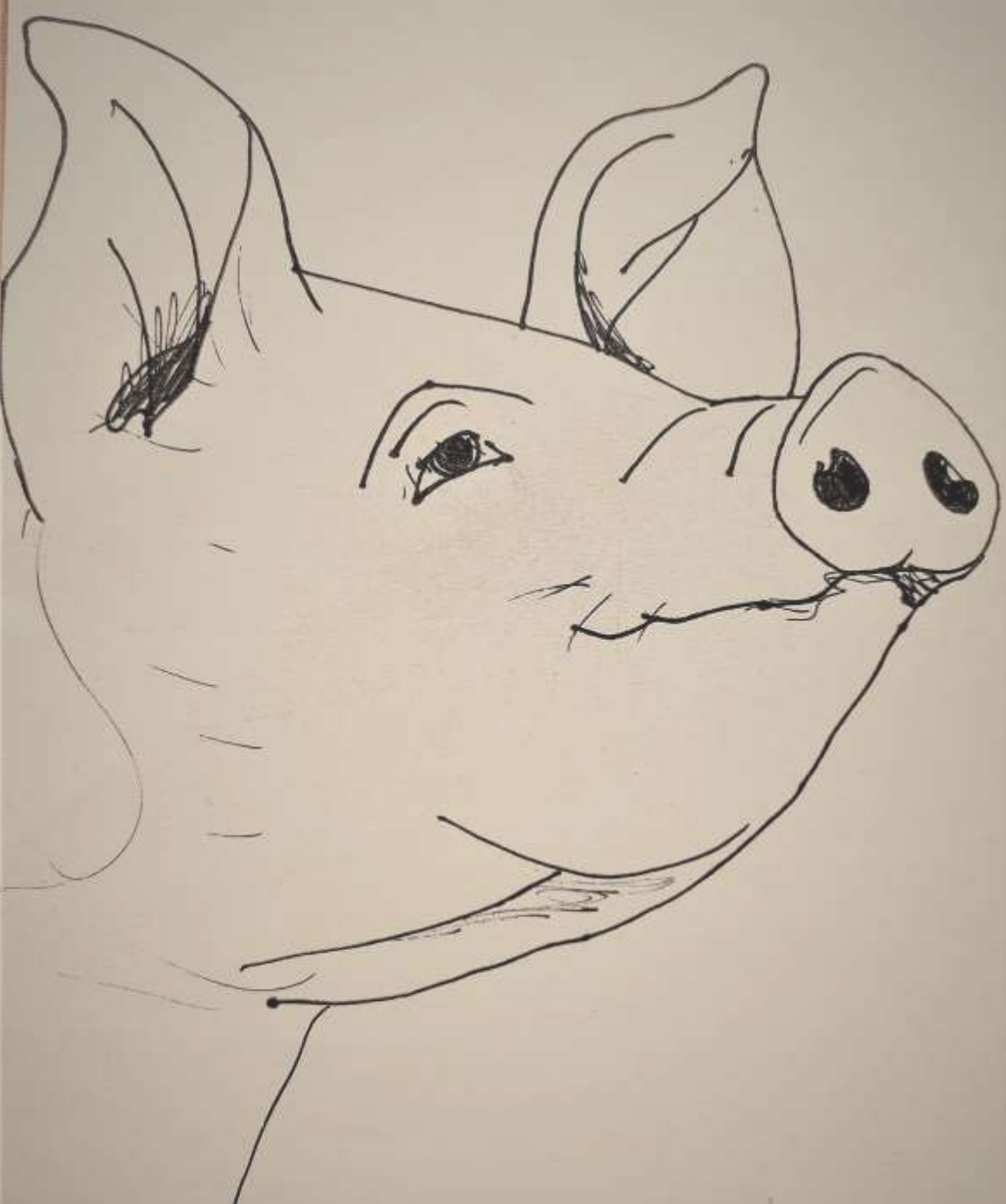
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Conclusion

Improved internal biosecurity,

*by particularly cleaning and
cleanability of flooring and
driving boards and
better control of flies,*

may increase the number of
hepatitis E virus negative batches of
pigs at slaughter



Acknowledgements



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