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healthy all life long

FOCUS ON BIOSECURITY FOR THE PREVENTION OF PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME (PRRS)

Dr. Marylène Tignon
Jorian Fiers

RF19/6335 PigRResponSe-project

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Introduction: PRRS

- Major production and economic losses

- Porcine Reproductive and Respiratory Syndrome (PRRS) affects pigs of all ages

- Clinical signs:

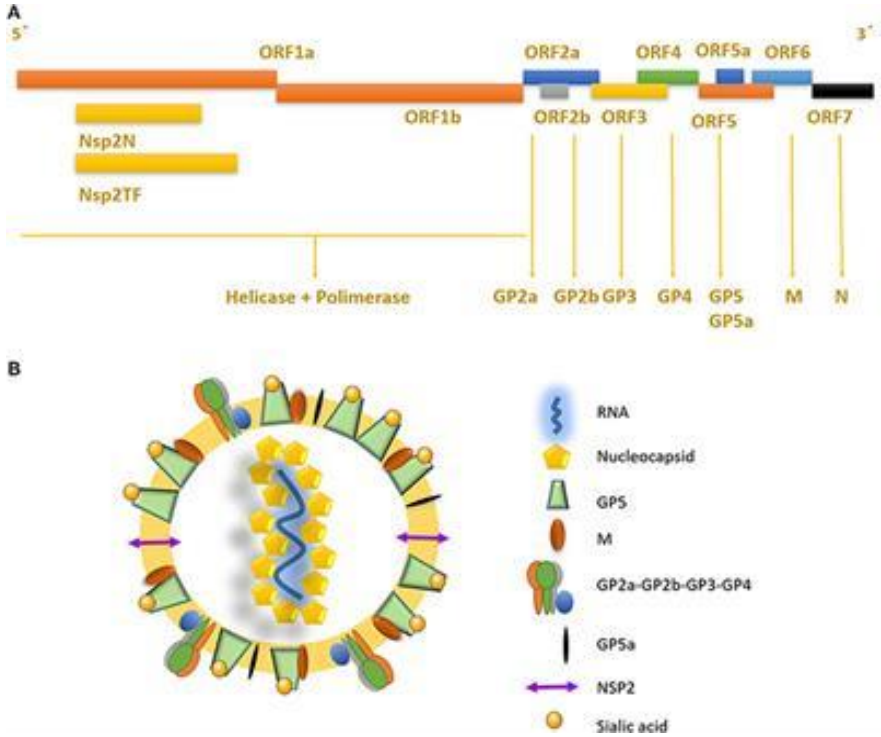
Reproductive failure in gilts, sows and boars

Respiratory problems in weaned piglets and/or fattening pigs

- Two main genotypes: PRRSv-1 (EU) & PRRSv-2 (NA)

- Porcine Respiratory Disease Complex (PRDC)

→ Antibiotic use!



Sergio Montaner-Tarbes *et al.* Vet.Sci. 2019

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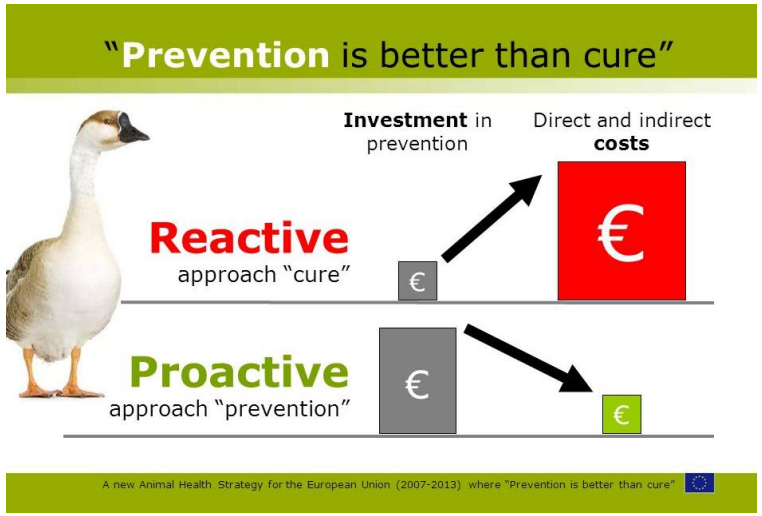
“Prevention is better than cure”

- Evaluation of the EU Animal Health policy 1995- 2004 (2006)
- New **Animal Health Strategy** for the European Union (2007-2013)
  - ➔ Regulation (EU) 2016/429 on transmissible animal diseases (‘Animal Health Law’) (AHL)



- ✓ More **prevention**
  - ✓ Biosecurity
  - ✓ Surveillance
  - ✓ Knowledge on animal health
  - ✓ Use of vaccines
  - ✓ Emerging diseases
  - ✓ Fight Antimicrobial Resistance
- ✓ **Easy and safe** trade

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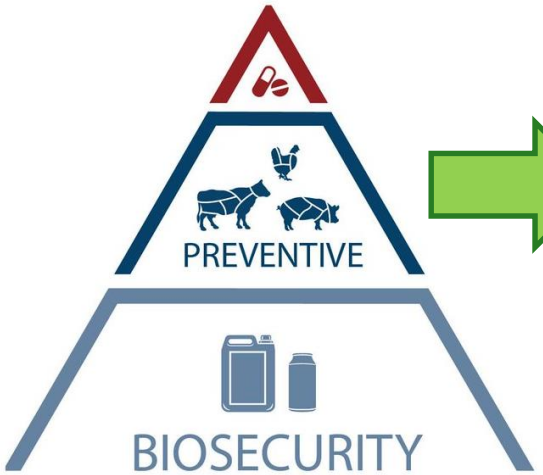
Prevention through monitoring



Surveillance

Use of Vaccines

PRRS-Monitoring

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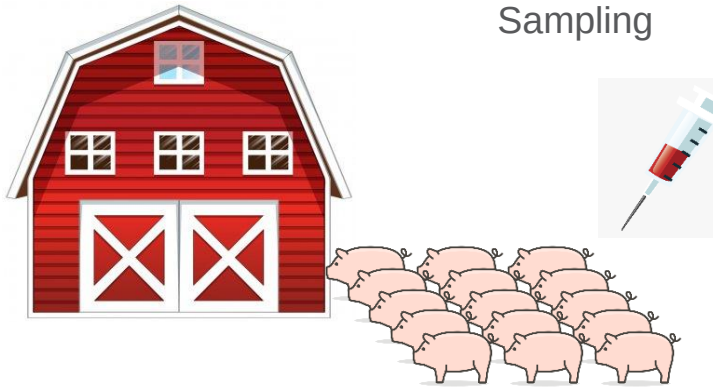
EN LEEFMILIEU

Started in 2015 : “BiggenMonitoring”

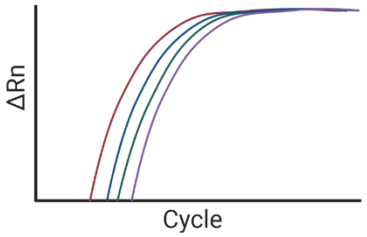
National voluntary program since 2018 : PRRS-Monitor (piglets, weaner, gilt /boar, herd)

-> Virus circulation & strain identification



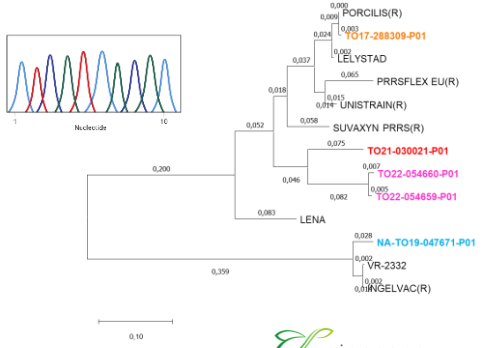
Sampling

PCR detection



POS

Sequencing & Phylogeny



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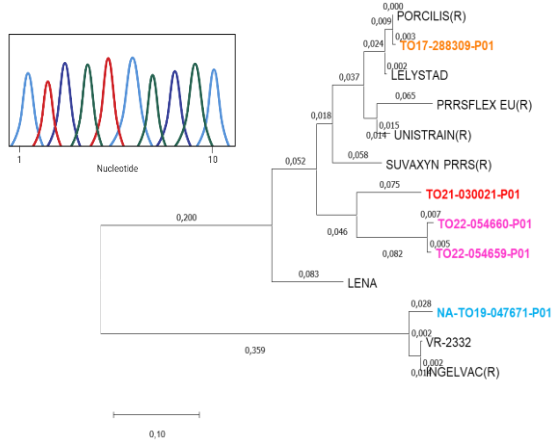
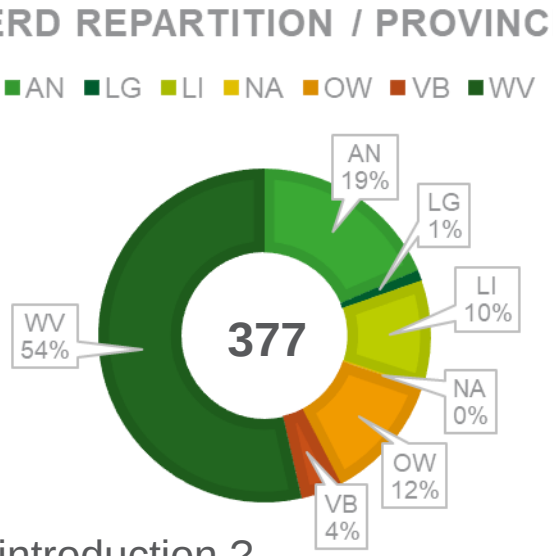
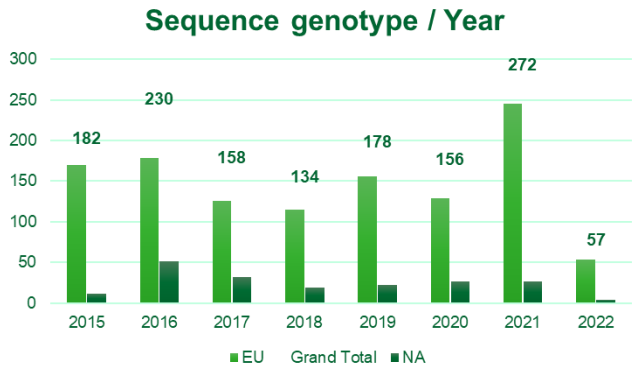
PRRS Monitoring : Strain Identification

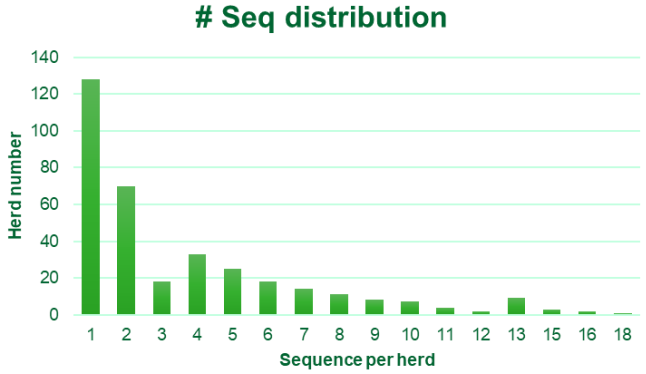


- **ORF5 sequencing**
  - More than 7 years of data
  - 377 Herds (19% AN, 10% LI, 12% OV, 54% WV)
  - Sequences obtained : 1367 (avg 188/year)
  - 86% PRRS genotype 1,1 (Lelystad)
  - 14% Genotype 2 (Ingelvac PRRS MLV)
  - Huge diversity in field 1,1 strains



- **Phylogenetic trees**
  - within herd : comparison with previous strains => new introduction ?
  - by sub-groups => connection and strain transmission (location clusters, networks)





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PRRS Monitoring : Recombination

- **Whole genome sequencing (WGS)**
  - Comparison with ORF5 : 124 samples (2015-2019)
    -> Highlight on the huge genetic variation inside the 1,1 genotype

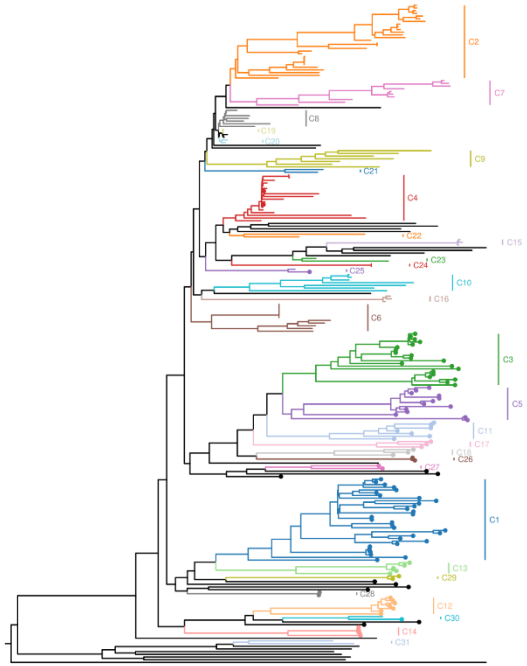

Figure 3. Maximum likelihood tree of the CDS dataset.

viruses MDPI

Article

WGS- versus ORF5-Based Typing of PRRSV: A Belgian Case Study

Frank Vandenbussche [1,*], Elisabeth Mathijs [2], Marylène Tignon [2], Tamara Vandersmissen [3] and Ann Brigitte Cay [2]

- Analysis on particular cases : e.g. strains with unexpected high homology to PRRSFLEX (no vaccination)

WGS vs ORF5 ->	PRRSFLEX (KT988004.1)	SS21-3-31_TO19-054634-016	SS21-3-28_TO19-032531-P01	SS21-3-29_TO19-032531-005
PRRSFLEX (KT988004.1)	100%	98%	97%	97%
SS21-3-31_TO19-054634-016	84%	100%	100%	100%
SS21-3-28_TO19-032531-P01	84%	99%	100%	100%
SS21-3-29_TO19-032531-005	84%	99%	100%	100%

=> Recombination between a PRRSV field strain and the PRRSFLEX vaccine strain with a single breakpoint at the beginning of ORF5

Recombination can compromise safety of vaccines
! Conditions of use

Transbound Emerg Dis. 2020 Sep; 67(5): 1786–1796.
Published online 2020 May 25. doi: 10.1111/tbed.13555
PMCID: PMC7540543
PMID: 32219985

A recombination between two Type 1 Porcine Reproductive and Respiratory Syndrome Virus (PRRSV-1) vaccine strains has caused severe outbreaks in Danish pigs

Lise Kirstine Kvisgaard, [1] Charlotte Sonne Kristensen, [2] Pia Ryt-Hansen, [1] Kasper Pedersen, [2] Tomasz Stadejek, [3] Ramona Trebbien, [4] Lars Ole Andresen, [1] and Lars Erik Larsen [1,5]

Horsens strain :

- Amervac vaccine strain (Unistrain) x 96V198 strain (Suvaxyn)
- highly transmissible + severe disease

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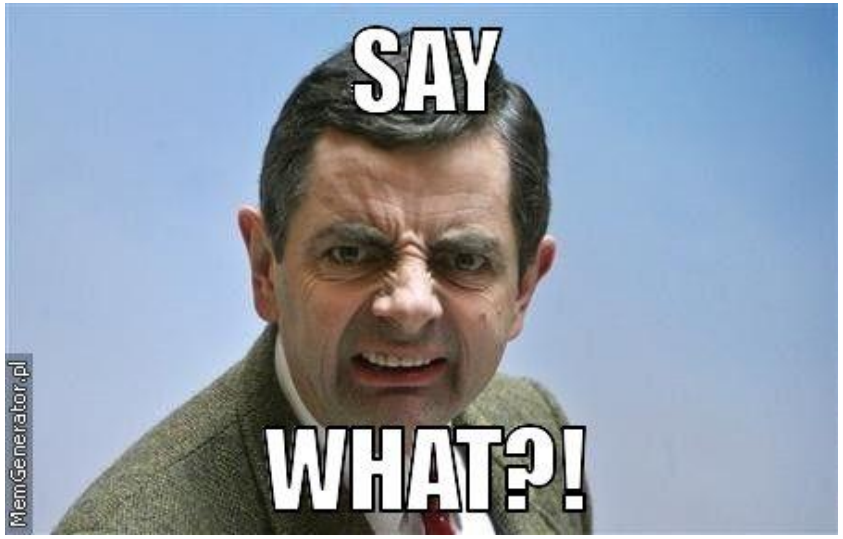
Prevention through vaccination



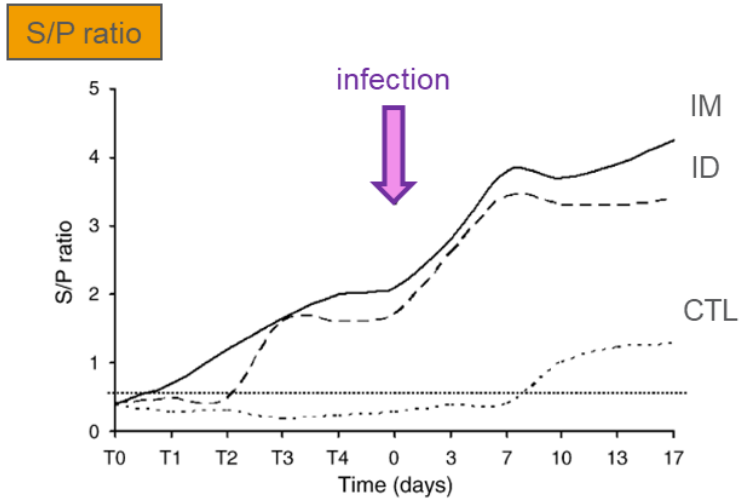
- The PRRS vaccination induces production of antibodies (Ab) targeting PRRSV
- The Ab presence can be measured in ELISA tests, VNT or IPMA
- The Ab presence is often used as a marker of success of vaccination

BUT

- The Ab presence is not correlated to protection (Yoon et al, 1997)
- Some vaccination 'failures' are reported :
  - Maternal immunity can impair the setting-up of vaccination in piglet (Dewey & Rajic, 2000)
  - Multi-vaccinated sows without ELISA detectable PRRS Abs are present in the field (Dewey & Rajic, 2000)
  - Up to 25-70% piglets without PRRS Ab production after vaccination ("non-responders") have been observed in the field (Martelli et al., 2007; 2009; Fablet et al., 2016; de Jong et al., 2016)

Prevention through vaccination : The 'Non Responders'

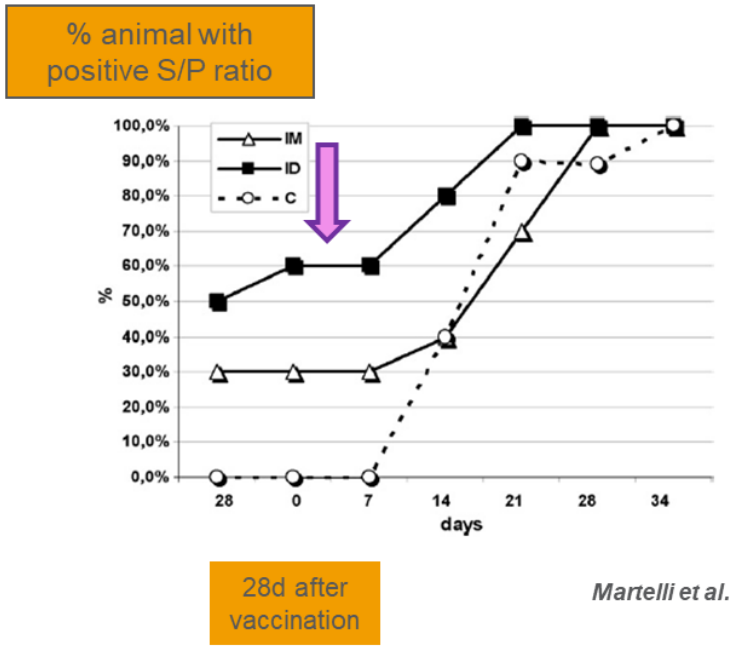
Seronegative 5w-piglets



28d after vaccination

Martelli et al. 2007

Vaccine Porcilis



28d after vaccination

Martelli et al. 2009

- *Serological responder: increase in S/P ratio 4w after vaccination*
- *Serological non-responder: no increase/decrease in S/P ratio 4w after vaccination*
- *40% NR with ID vaccination vs. 70% NR with IM vaccination*

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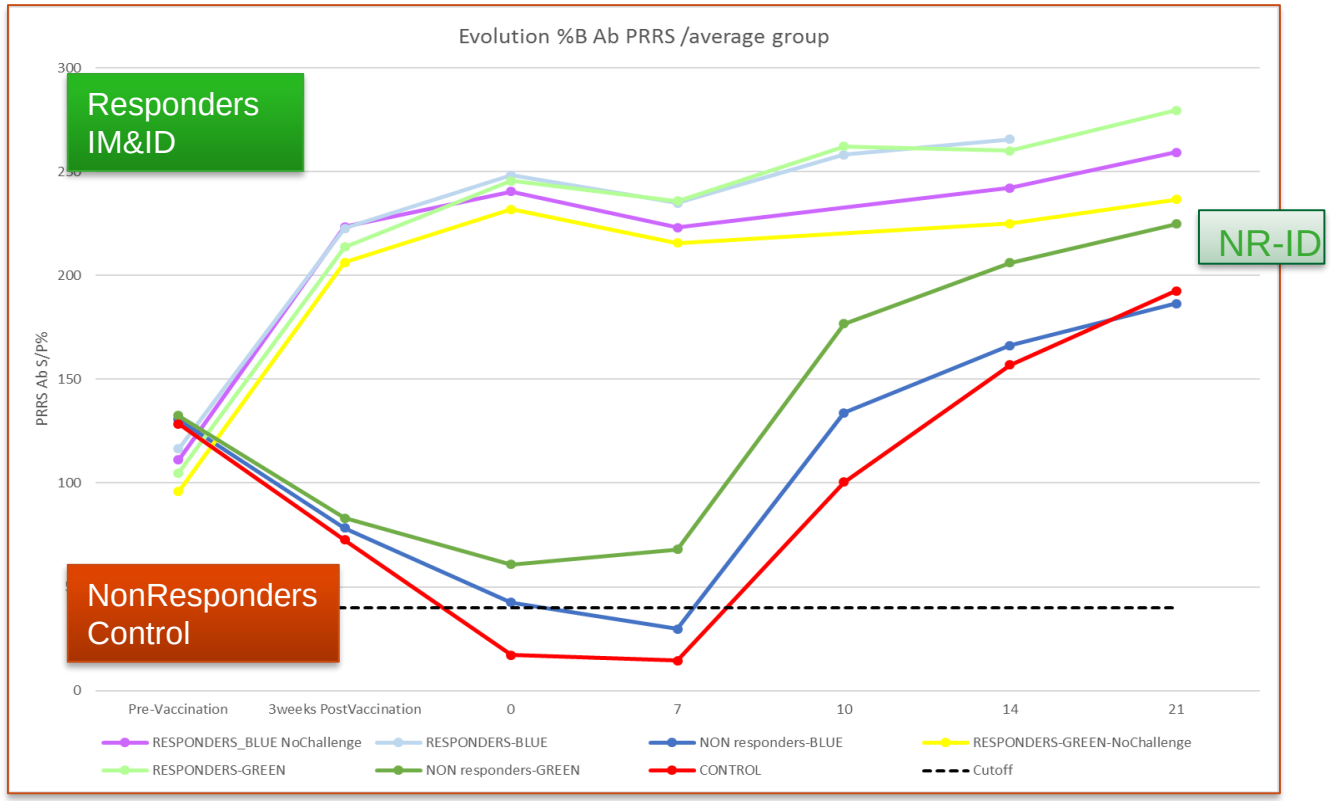
Prevention through vaccination : The 'Non Responders'

- Challenge of 5 groups of animals (NR-IM, R-IM, NR-ID, R-ID and Controls) - Two groups of responders (R-IM and R-ID) remained unchallenged
- Intranasal inoculation of 2 ml of 2 x10E5 TCID of PRRSV (Flanders/13 = 13V091) [1 ml per nostril].



Serological response = not suitable for individual evaluation of vaccination succes

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Take Home message

- **Importance of monitoring for prevention** :
  - Detection of PRRSv presence

- **Molecular Identification of circulating strains**
  - New introduction – tracking origin of infection
  - Identify cluster of transmission and networks
  - Identify genotypes with higher virulence
  - Recombination : risk of reversion through high virulence

- **Importance of vaccination as prevention tool**
  - Caution in use (recombination possible)

PigRResponSe project: Objectives

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EN LEEFMILIEU

- Establish the prevalence of ELISA non-responding vaccinated sows
- Analyse the neutralizing antibodies of the ELISA non-responding sows
- Analyse factors related to ELISA seronegativity

→ First field study

- Establish the consequence of the sow immune status for the progeny → Second field study

- Trigger seroconversion in non-responding animals
- Analyse the cell-mediated immunity of ELISA non-responding animals

→ Experimental studies

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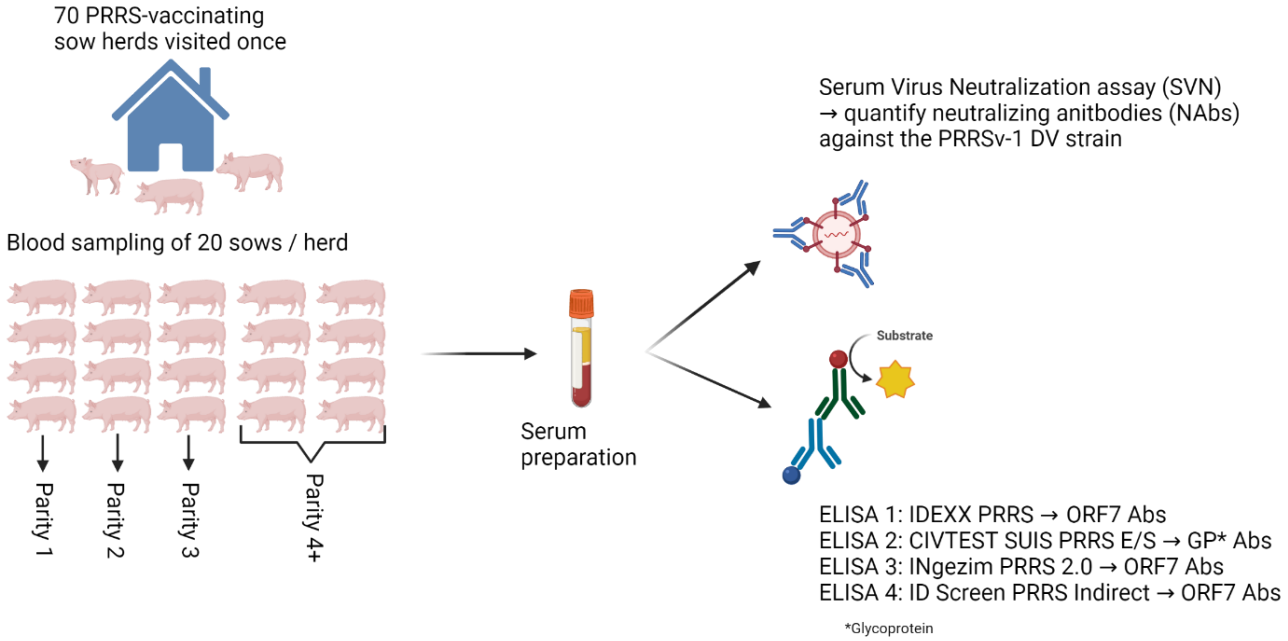
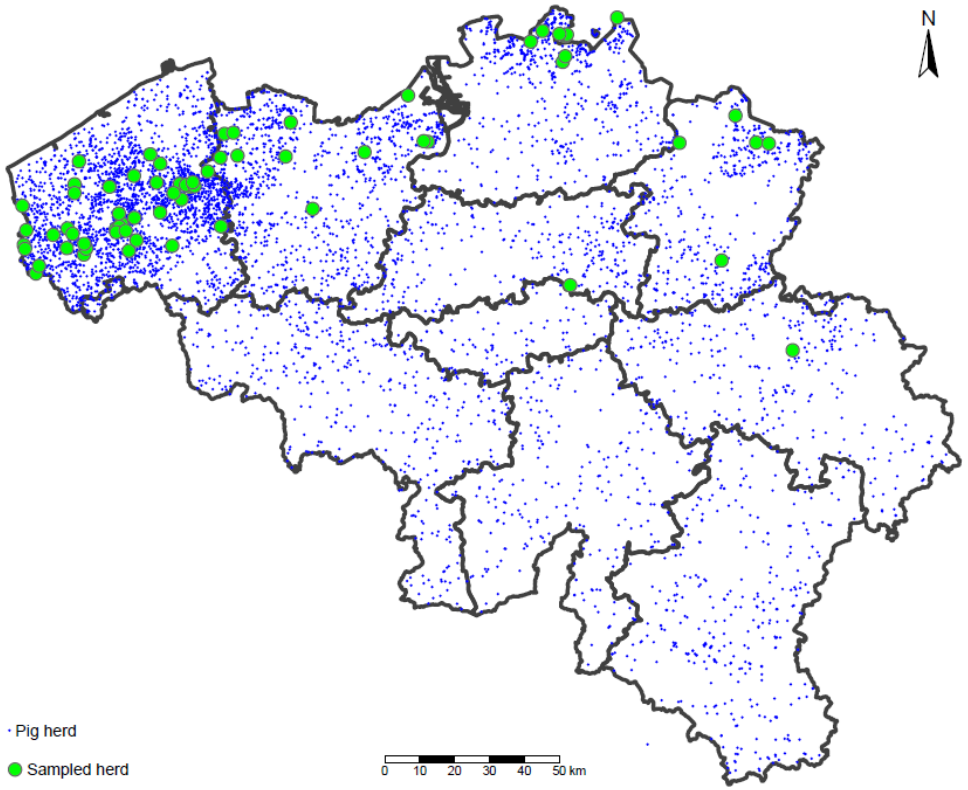
PigRResponse Project

- First field study: assess presence of PRRS-vaccinated, seronegative sows in Belgium





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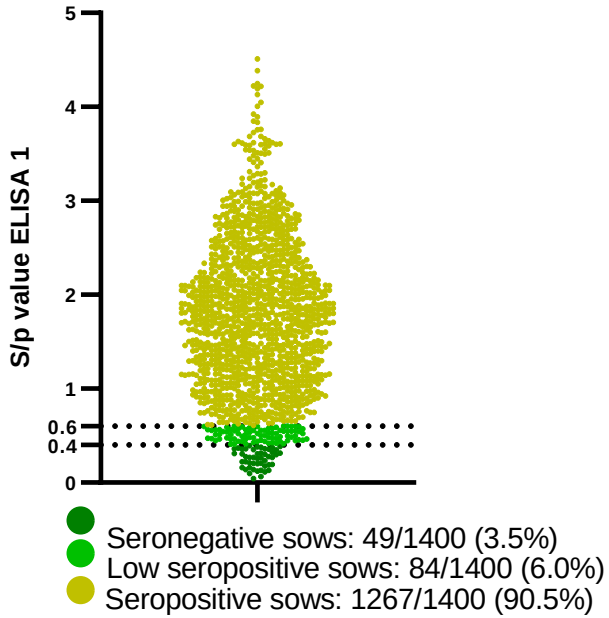
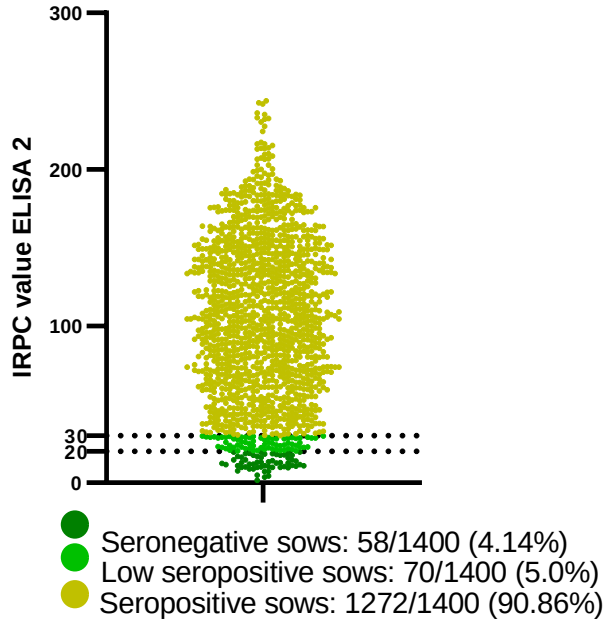
PigRResponse Project

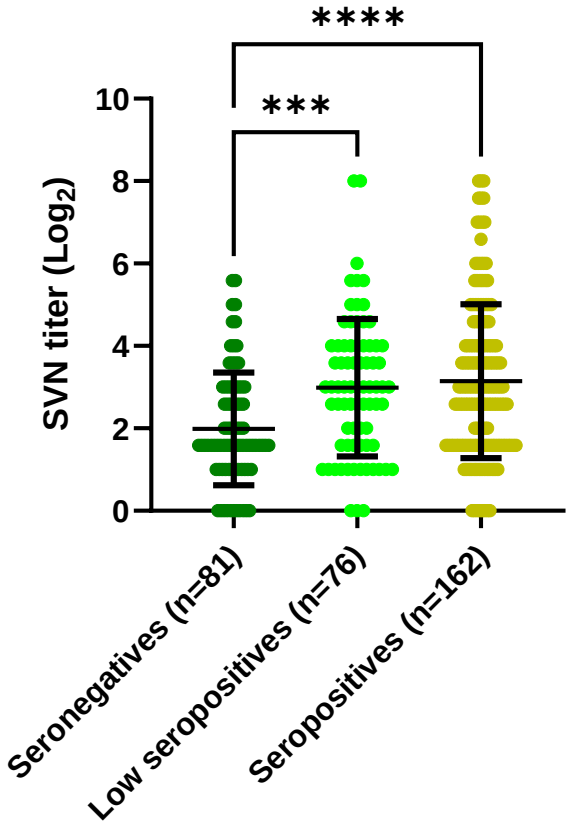
- First field study: assess presence of PRRS-vaccinated, seronegative sows in Belgium

  → At least one seronegative sow in 40% of the herds!!

  → ELISA seronegatives have significantly less NAbs







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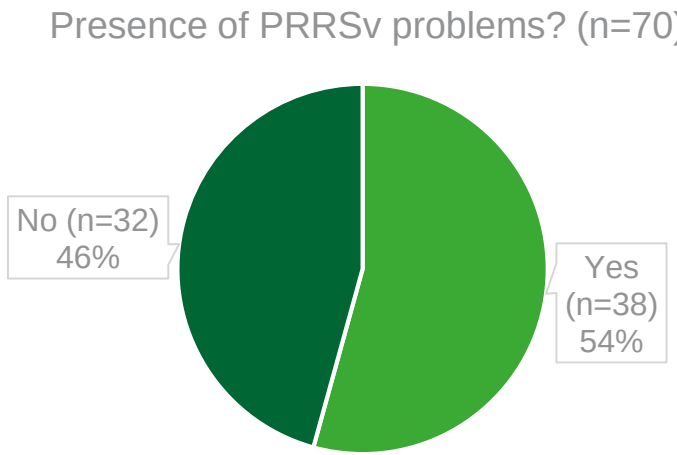
PigRResponSe project – Secondary analysis

- Visit of 70 sow herds (capacity > 150 sows) → questionnaires (PRRSv-specific + BioCheck)

- Secondary analysis → trends in biosafety practices and presence of PRRSv problems?
  → identify critical biosecurity points in context of PRRSv problems

- Presence of PRRSv problems (sows – piglets – fattening pigs):



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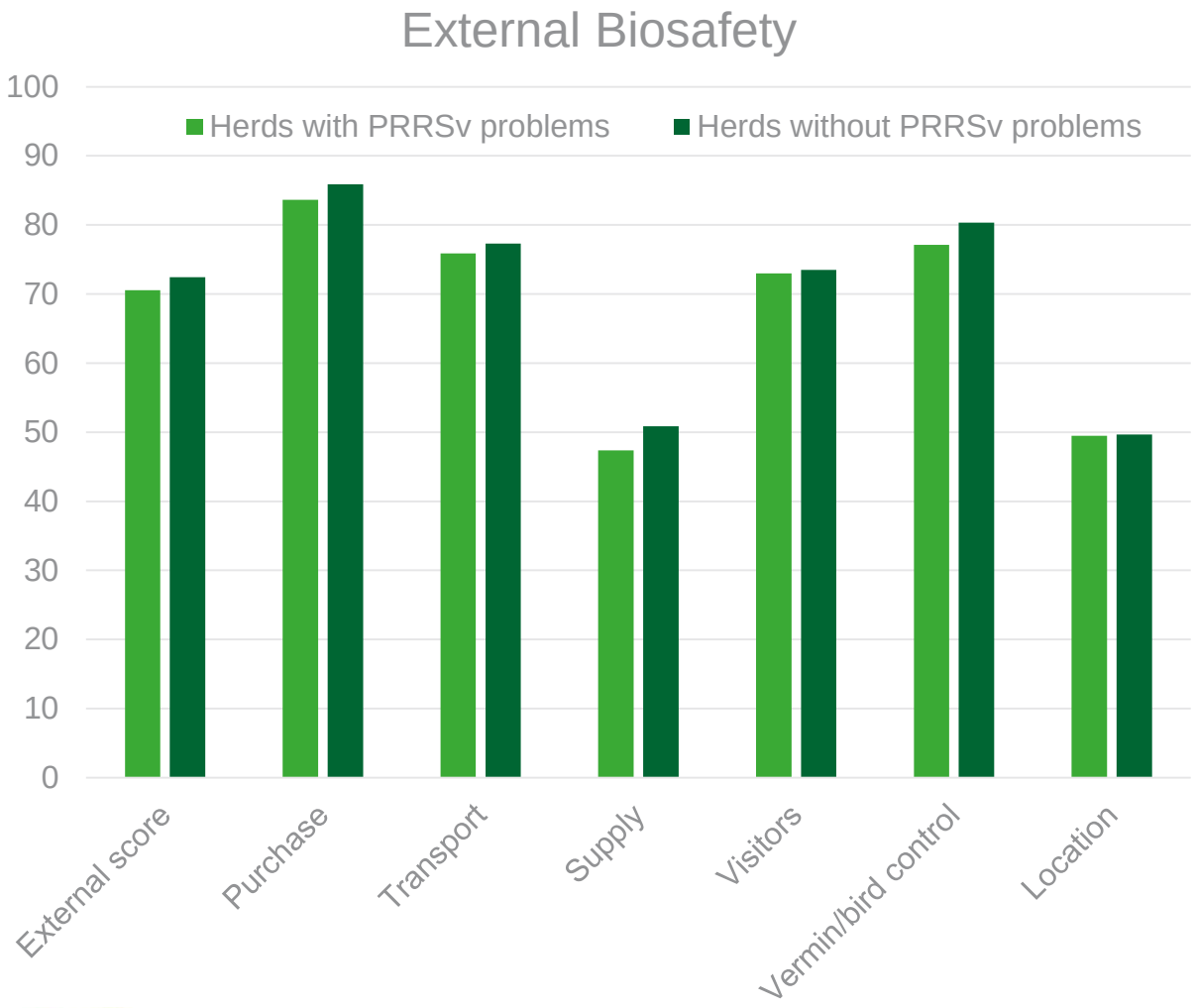
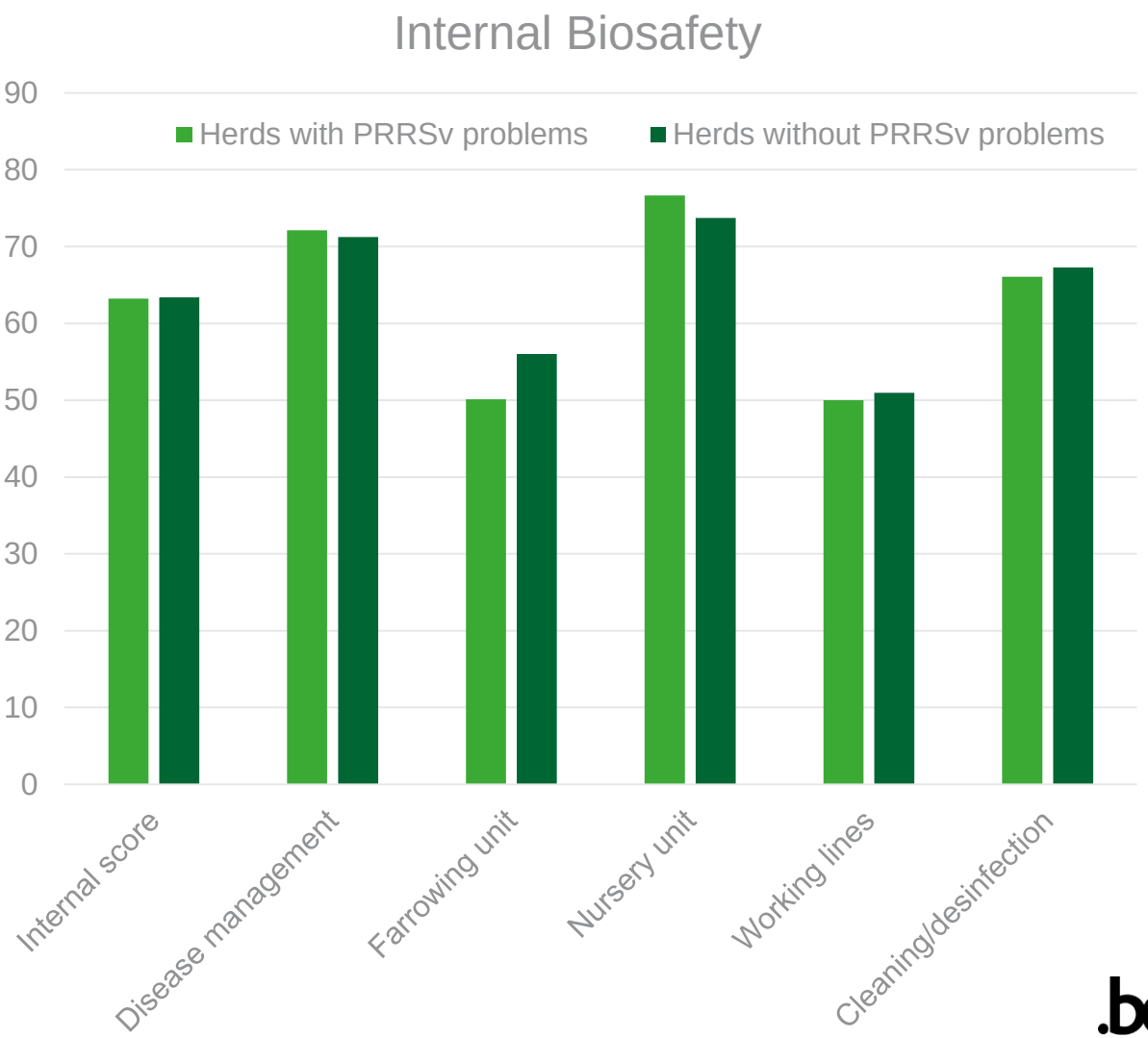
Biocheck scores ~ PRRSv problems





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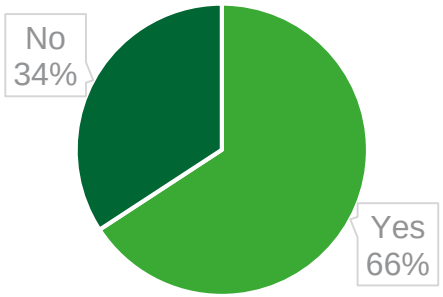
External Biosafety – Direct route of PRRSv introduction

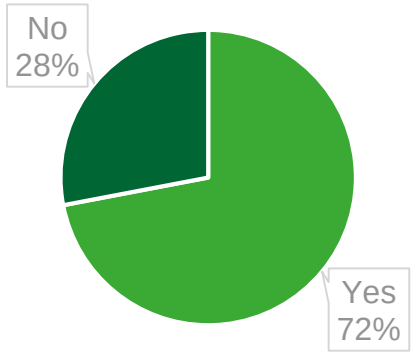
- PRRSv shedding possible via blood, saliva, milk/colostrum, urine, feces, **semen**
- ! Purchase management of breeding material !
  - → PRRSv naïve sources with routine health monitoring
  - → Isolation / quarantine + monitoring + testing of purchased animals

Herds with PRRSv problems

Purchasing of gilts (n=38)

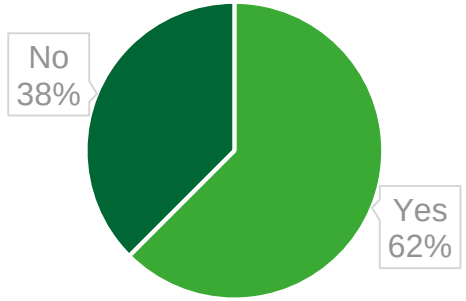


Sanitary statute origin farm? (n=25)

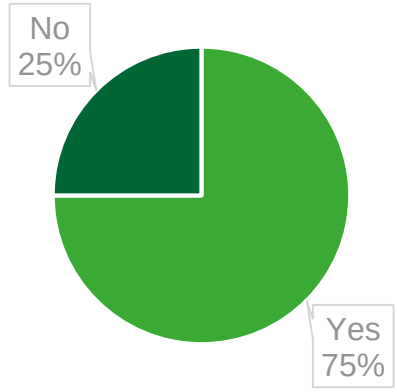


Herds without PRRSv problems

Purchasing of gilts (n=32)



Sanitary statute origin farm? (n=20)



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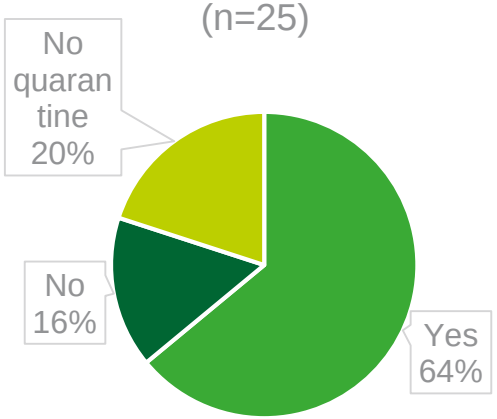
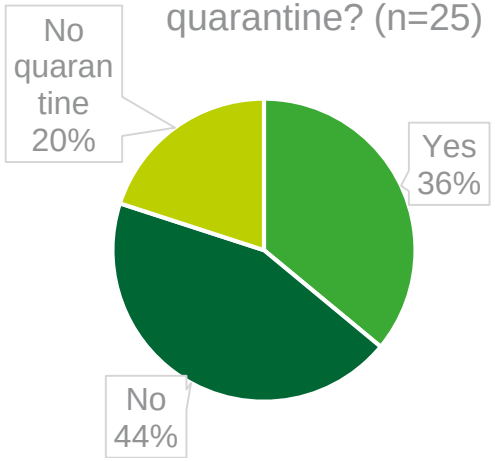
Herds with PRRSv problems

AI/AO in quarantine? (n=25)

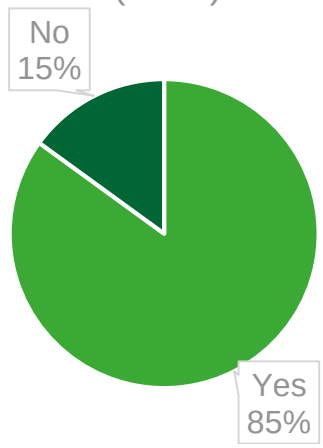


Hygiene lock for quarantine? (n=25)



Herds without PRRSv problems

AI/AO in quarantine? (n=20)



Hygiene lock for quarantine? (n=20)

Median of 42 days of quarantine in both groups

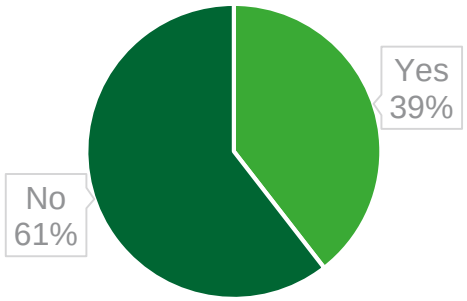
External Biosafety – Indirect route of PRRSv introduction

- Mechanical transmission of PRRSv has been described ; more frequent in cold weather [1,2]
  → Viability of PRRSv ↓ when temperature ↑
- **Transport vehicles**, personnel/visitors (hands, coveralls, boots), materials, aerosols

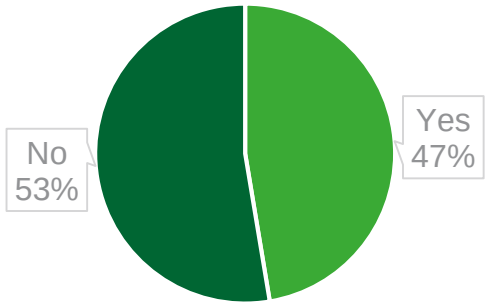
[1]. Dee *et al*. Can J Vet Res. 2002
[2]. Dee *et al*. Can J Vet Res. 2003

Herds with PRRSv problems

Feed transport via dirty road? (n=38)



Manure removed via dirty road? (n=38)



Herds without PRRSv problems

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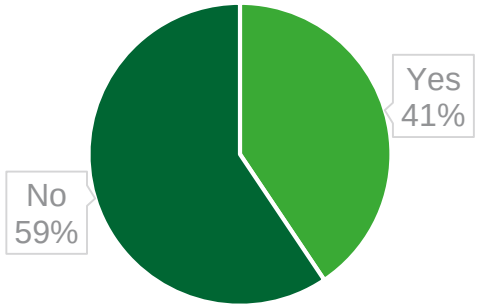

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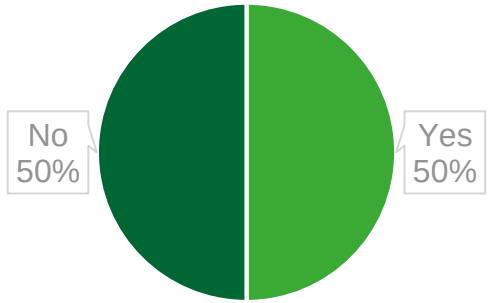
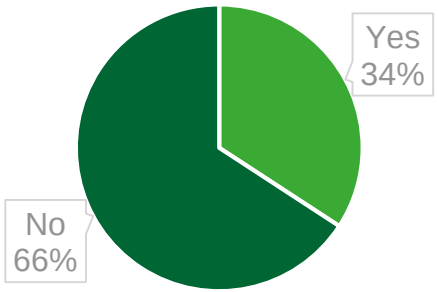


External Biosafety – Indirect route of PRRSv introduction

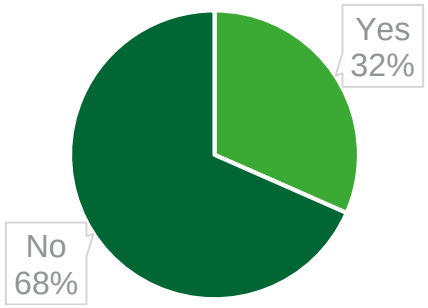
- Mechanical transmission of PRRSv has been described ; more frequent in cold weather [1,2]
  → Viability of PRRSv ↓ when temperature ↑
- Transport vehicles, **personnel/visitors (hands, coveralls, boots)**, materials, aerosols

Herds with PRRSv problems

Only access trough hygiene lock (n=38)



Strict separation in hygiene lock? (n=38)



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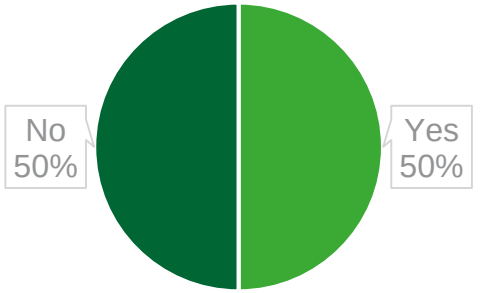

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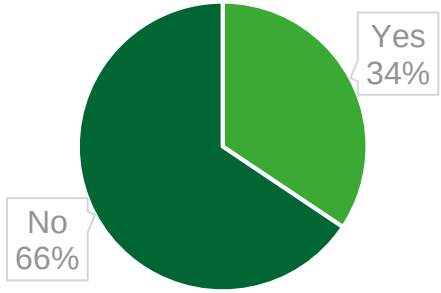

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External Biosafety – Indirect route of PRRSv introduction

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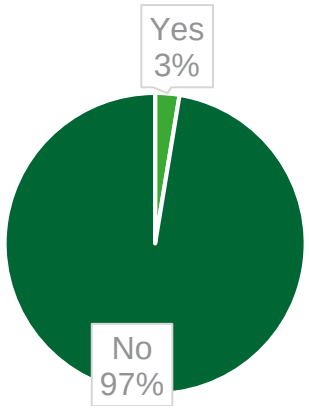
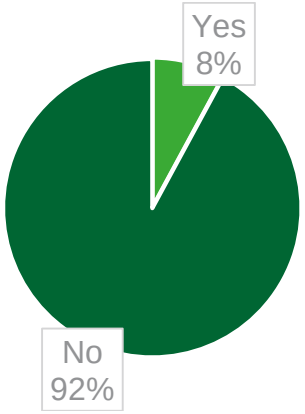
- Transport vehicles, personnel/visitors (hands, coveralls, boots), **materials**, aerosols

Herds with PRRSv problems

Specific pass-trough for materials? (n=38)

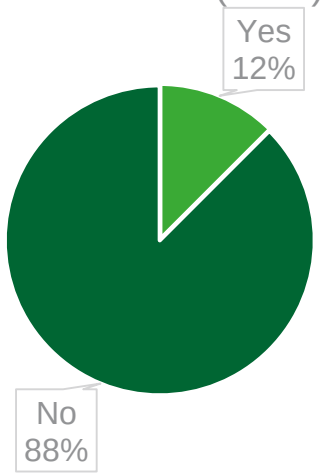


Specific measures for introduction of materials?(n=38)

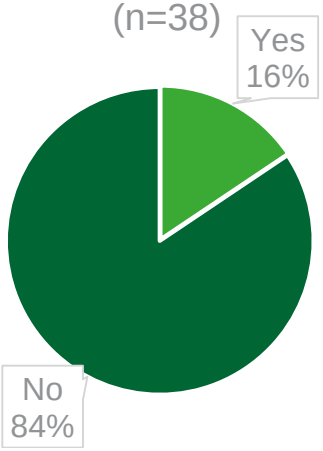


Herds without PRRSv problems

Specific pass-through for materials? (n=32)



Specific measures for introduction of materials? (n=38)



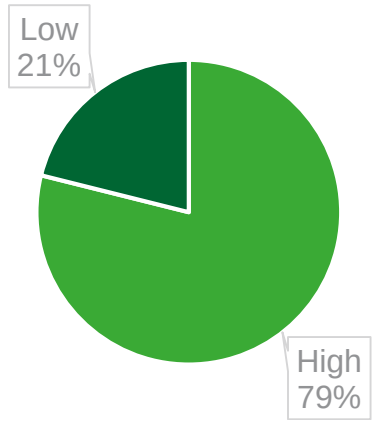
[1]. Dee *et al*. Can J Vet Res. 2002
[2]. Dee *et al*. Can J Vet Res. 2003

External Biosafety – Indirect route of PRRSv introduction

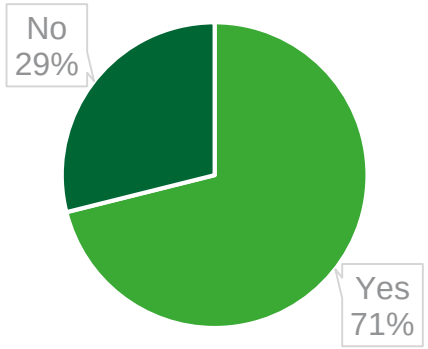
- Mechanical transmission of PRRSv has been described ; more frequent in cold weather [1,2]
  → Viability of PRRSv ↓ when temperature ↑
- Transport vehicles, personnel/visitors (hands, coveralls, boots), materials, **aerosols**

Herds with PRRSv problems

Location pig density (n=38)

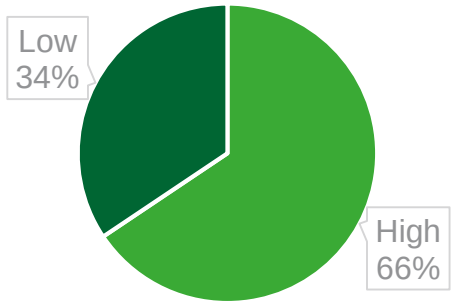


Presence of another herd within 500m? (n=38)

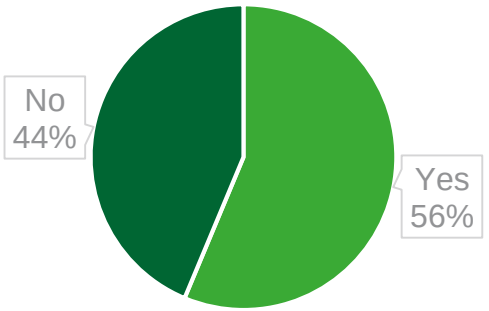


Herds without PRRSv problems

Location pig density (n=32)



Presence of another herd within 500m? (n=32)



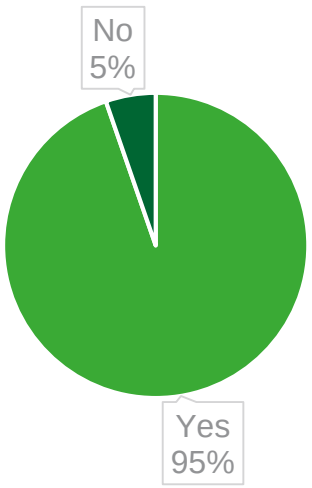
[1]. Dee *et al*. Can J Vet Res. 2002
[2]. Dee *et al*. Can J Vet Res. 2003

Internal Biosafety – prevention of PRRSv spread

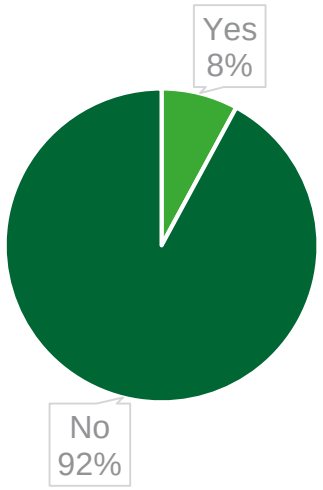
- Prevention of PRRSv spread within the herd→ good internal biosafety
- **AI/AO**, measures between compartments, working lines, cleaning and disinfection

Herds with PRRSv problems

AI/AO in nursery? (n=38)

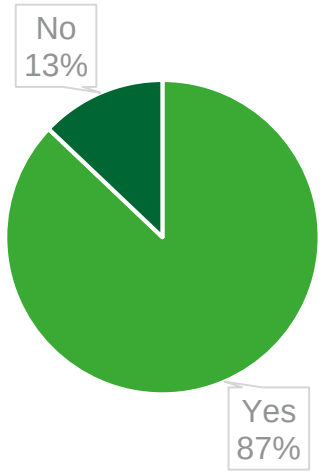


Mixing young-old in nursery? (n=38)

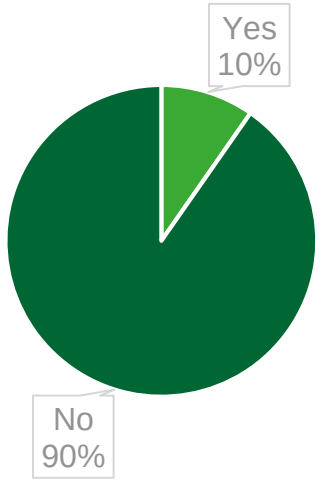


Herds without PRRSv problems

AI/AO in nursery? (n=31)



Mixing young-old in nursery? (n=31)



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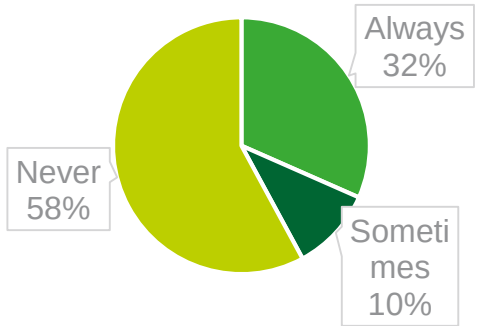
Internal Biosafety – prevention of PRRSv spread

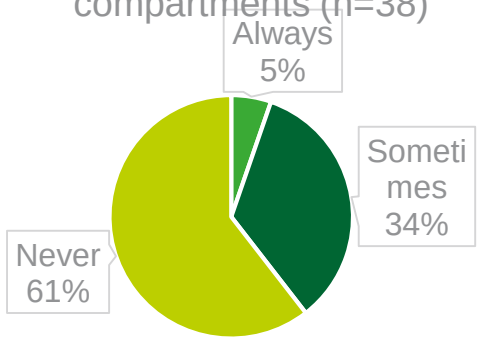
- Prevention of PRRSv spread within the herd→ good internal biosafety
- AI/AO, **measures between compartments**, working lines, cleaning and disinfection

Herds with PRRSv problems

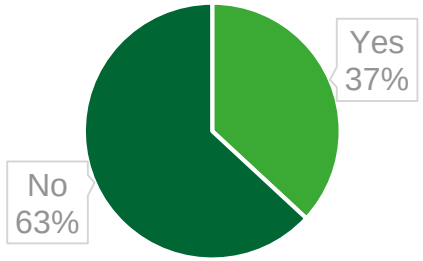
Compartment-specific clothing (n=38)



Washing of hands between compartments (n=38)

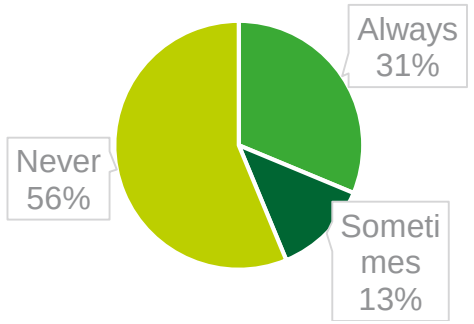


Boot changing/cleaning between compartments (n=38)



Herds without PRRSv problems

Compartment-specific clothing (n=32)



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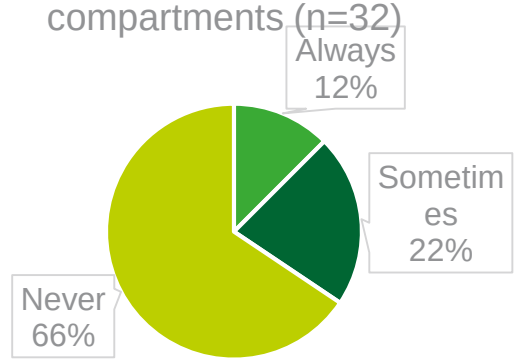

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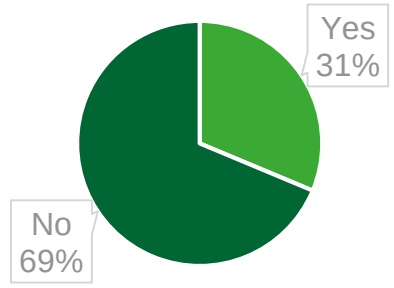
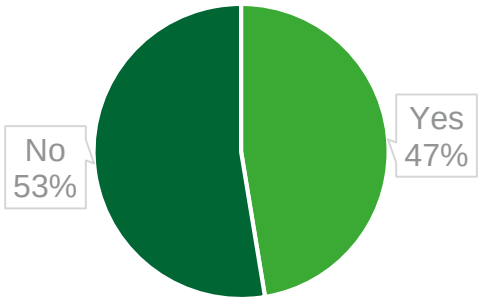


Internal Biosafety – prevention of PRRSv spread

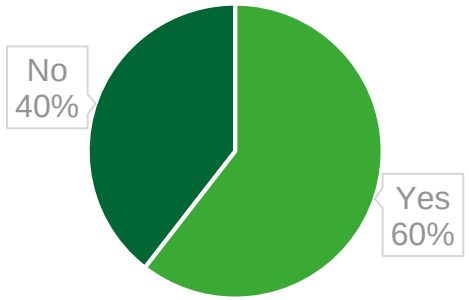
- Prevention of PRRSv spread within the herd→ good internal biosafety
- AI/AO, measures between compartments, **working lines**, cleaning and disinfection

Herds with PRRSv problems

Working from young → old (n=38)

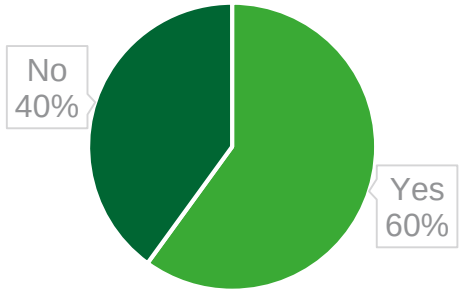


Material according to working lines (n=38)



Herds without PRRSv problems

Working from young → old (n=32)



Material according to working lines (n=32)

Internal Biosafety – prevention of PRRSv spread

- Prevention of PRRSv spread within the herd→ good internal biosafety
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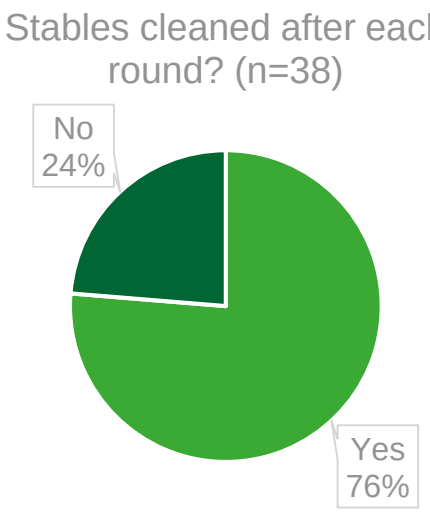
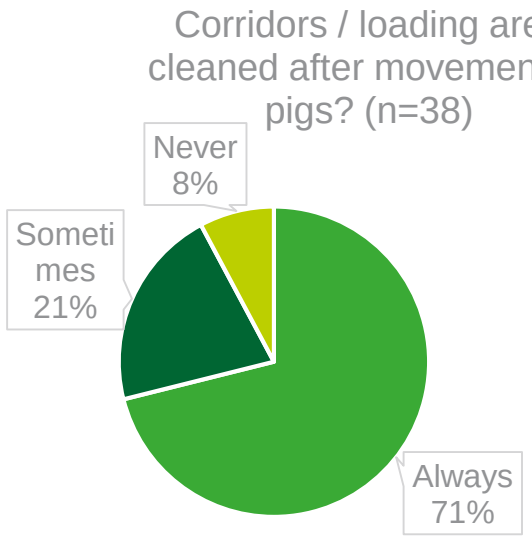
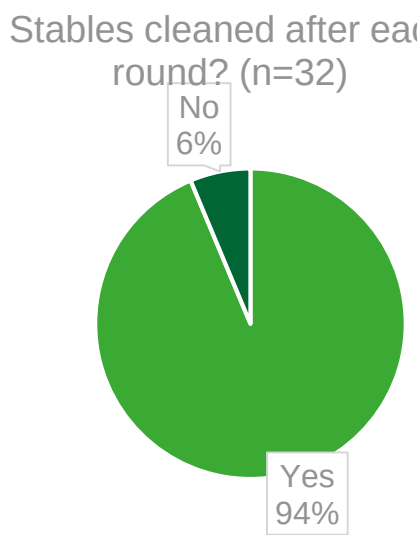
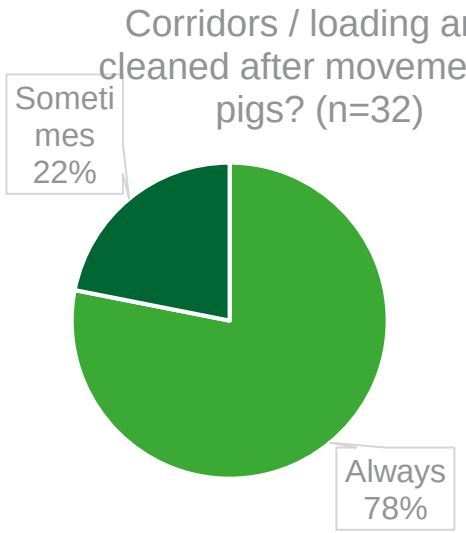
Herds with PRRSv problems





Herds without PRRSv problems





Conclusion: main attention points

External Biosafety

Correct use of quarantine unit purchased gilts
→ AI/AO & hygiene lock

Sanitary statue origin farm!

Correct use of hygiene lock personnel/visitors
→ Separation clean-dirty part
→ Only access stables via hygiene lock
→ If not possible: use of boot cleaners **before** entry!

Measures **before** introducing new materials
→ Quarantine / cleaning and disinfection

Internal Biosafety

Measures between compartments!
→ Compartment-specific clothing
→ Washing of hands
→ Washing / changing boots

Work from old → young

Cleaning / disinfection
→ After **each** round
→ After movement of pigs
→ Use of correct products
→ Sanitary break

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