Postweaning mortality: Key findings through data analysis

PROSPER

Predictors of Swine Performance

54th AASV Annual Meeting

Improving Pig Survivability through Research and Industry Collaboration

IOWA STATE UNIVERSITY
College of Veterinary Medicine

Iowa Select FARMS

HANOR

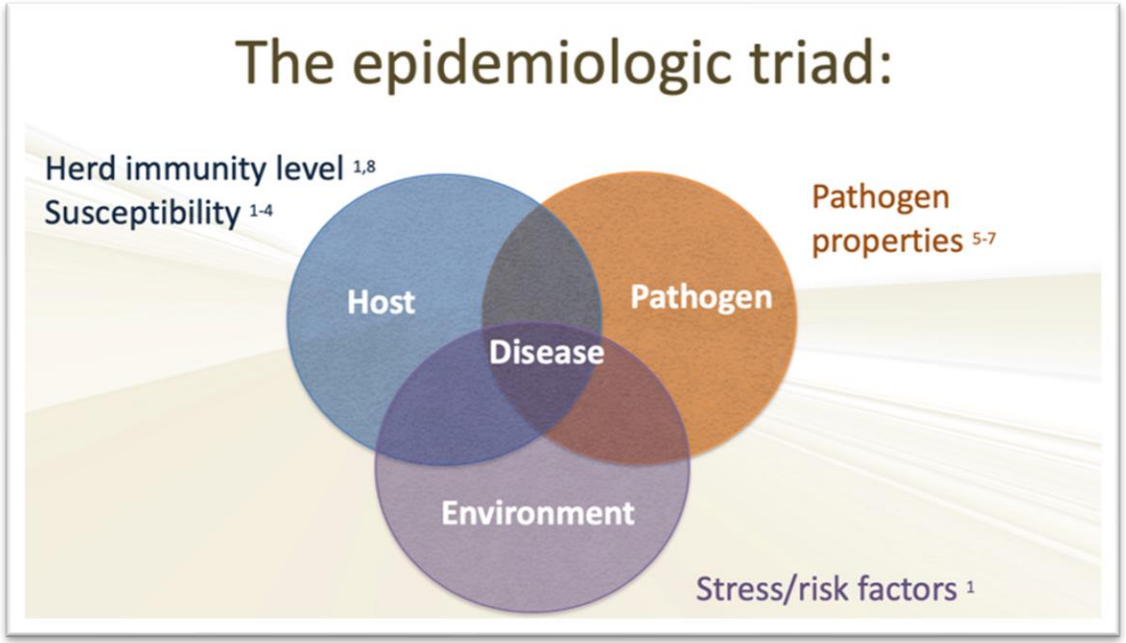
USDA

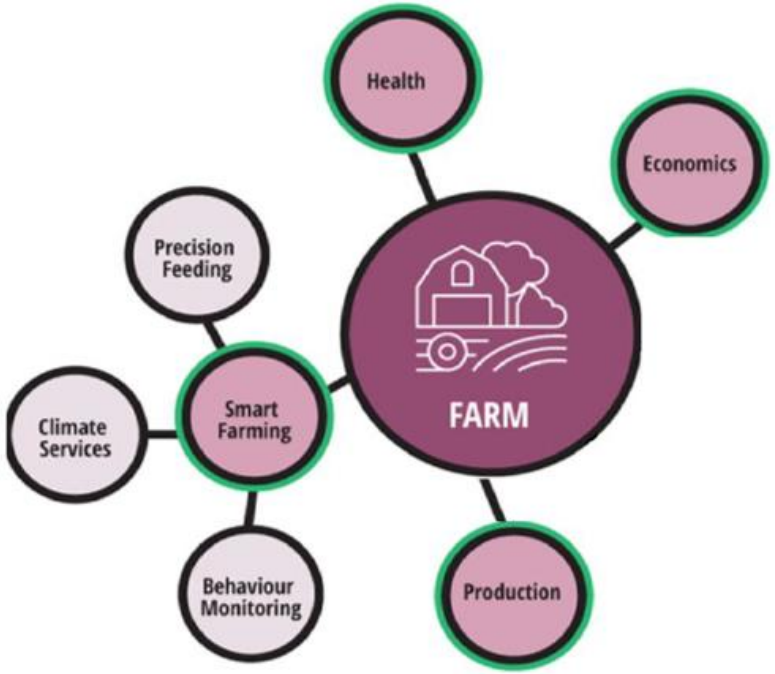
Outline

- PROSPER data wrangling pipeline
- Major risk factors of mortality
- Causal analysis of mortality through observational data
- Predicting mortality through data

Rationale

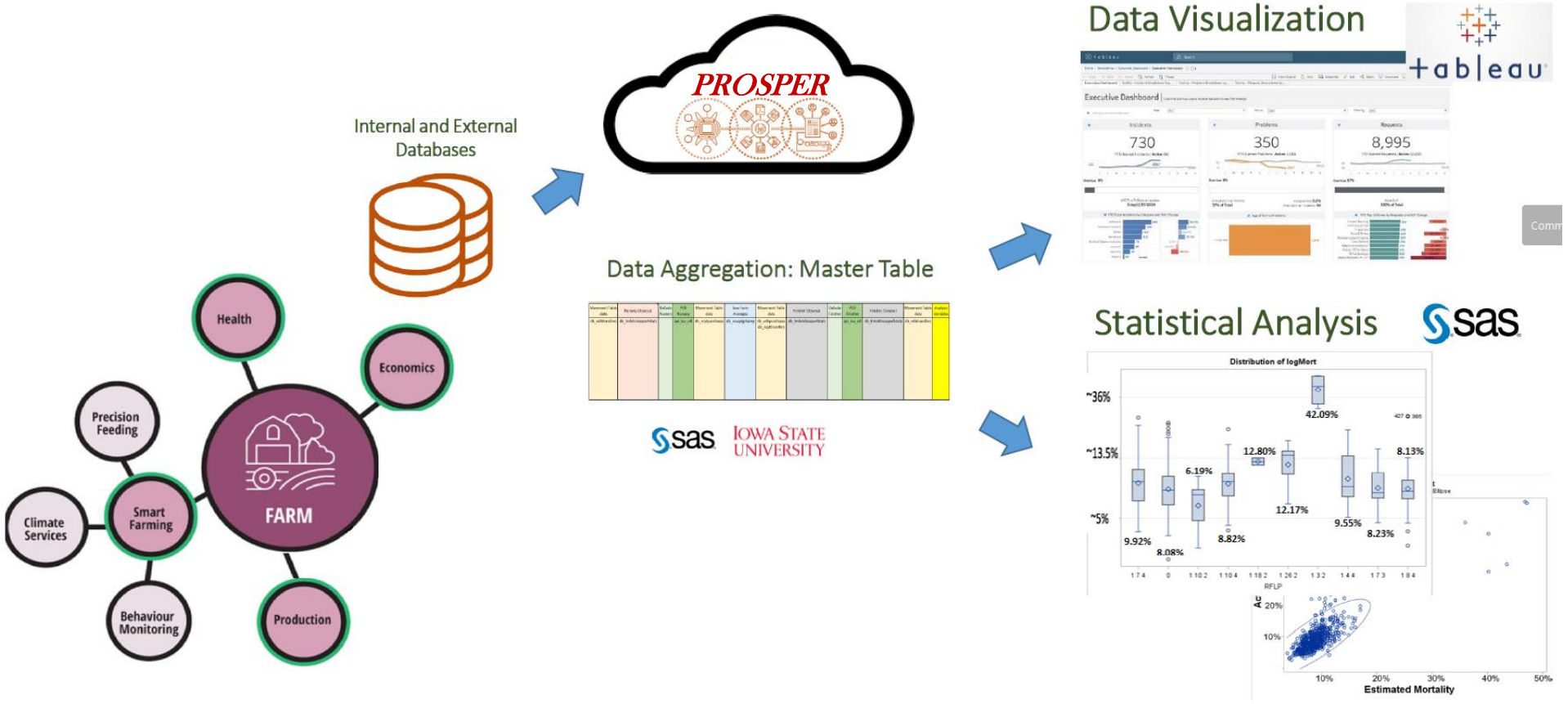
- Productivity in swine operations is greatly affected by multiple factors involving the epidemiological triad.
- Interaction among these factors is dynamic and fluid over time.
- Producers gather information about these factors, but the data is stored in multiple formats and scattered across different software or files.



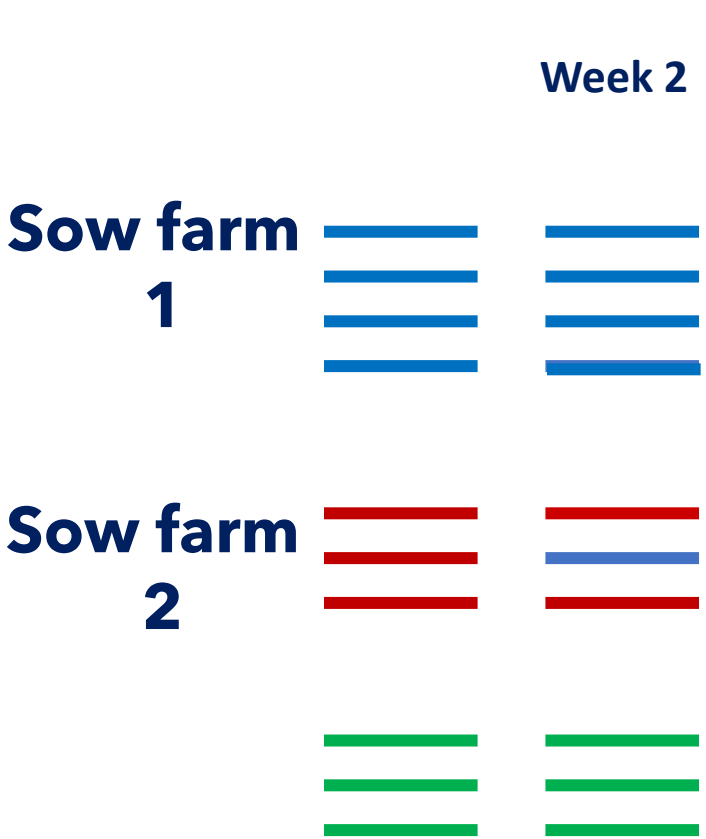


Rationale

- *Critical need for near-real time multiscale big-data consolidation approaches, allowing interactive analysis of swine data and the application of precision swine health & productivity management.*

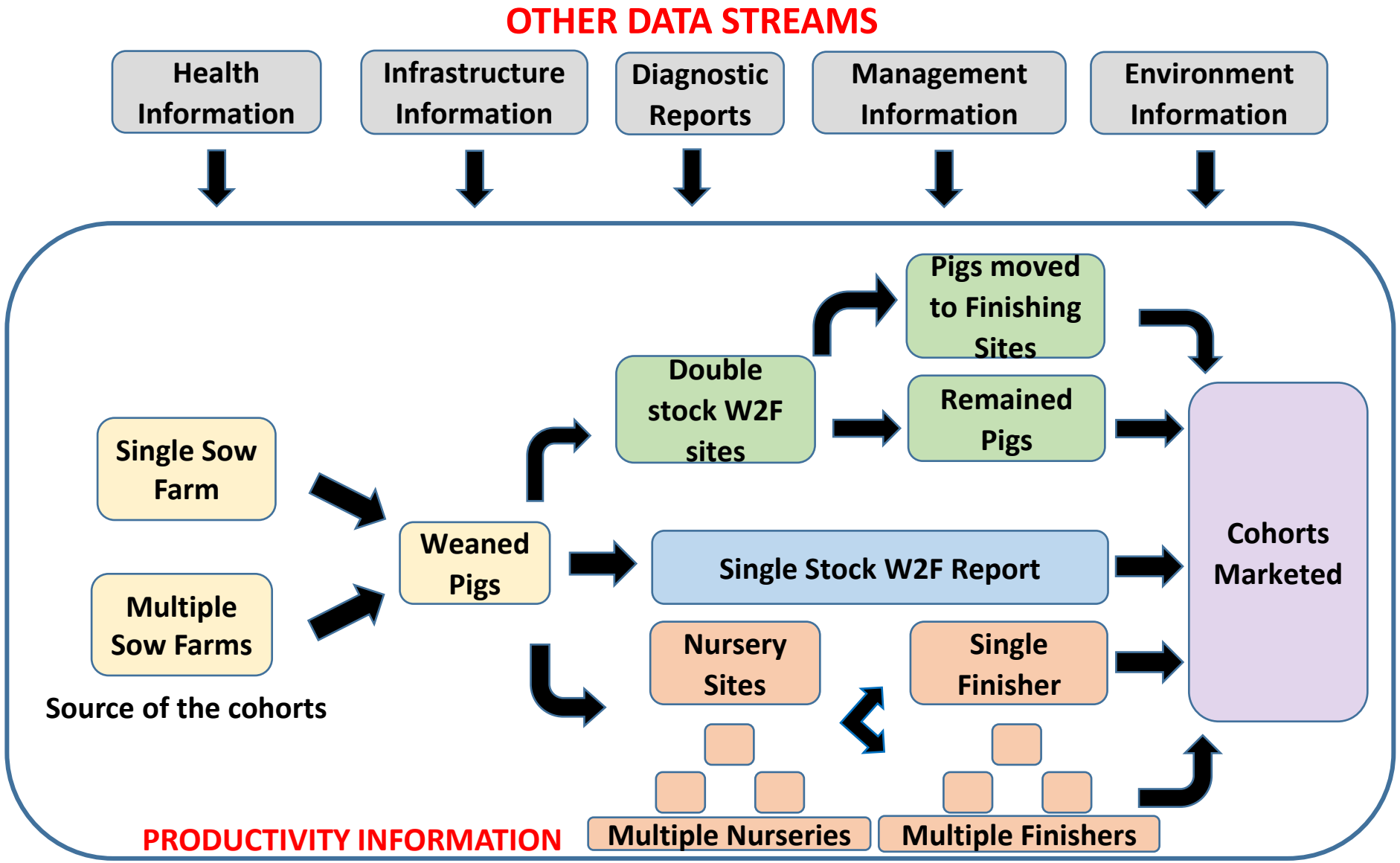


Breeding → Farrowing → Weaning → Nursery → Finisher → Market

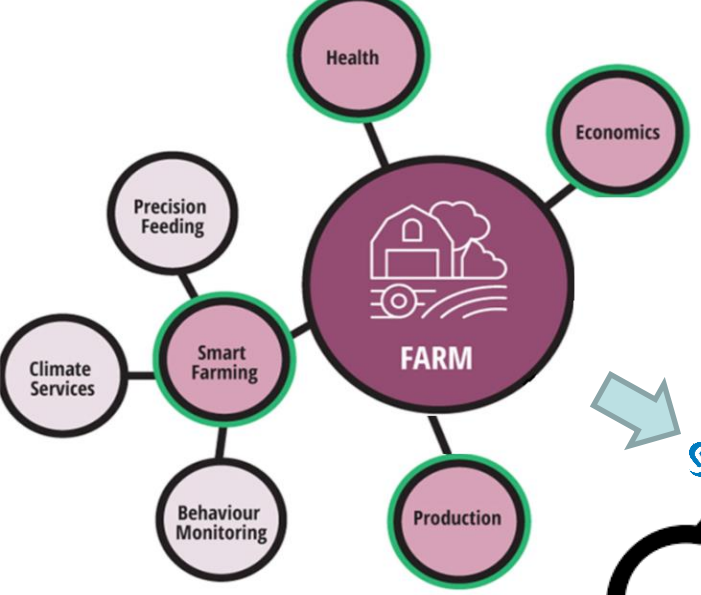


Nursery **Finisher**

Production system data streams and flow



Master table



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Veterinary Diagnostic Laboratory

sas

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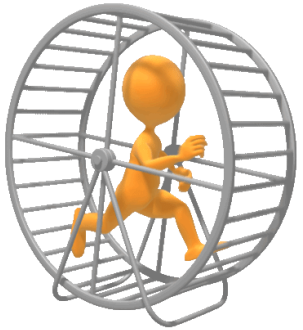
Master Table



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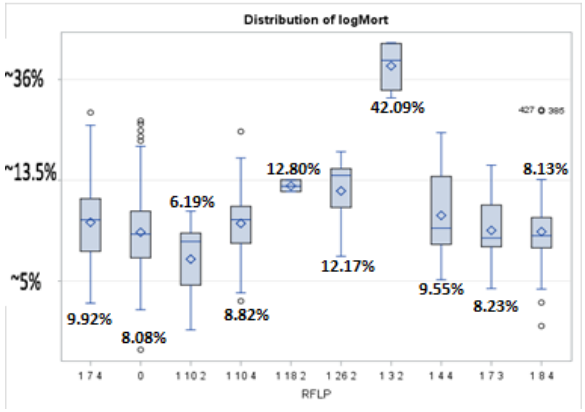

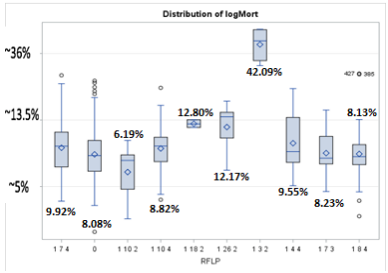

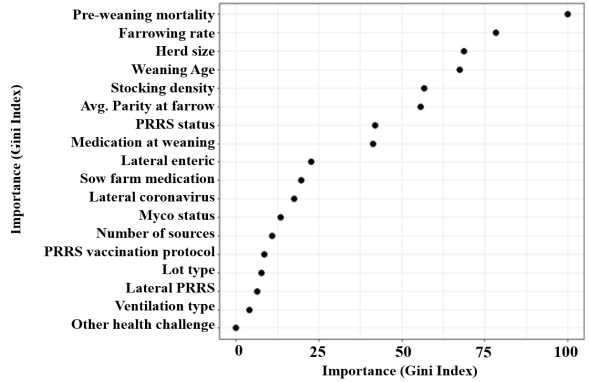

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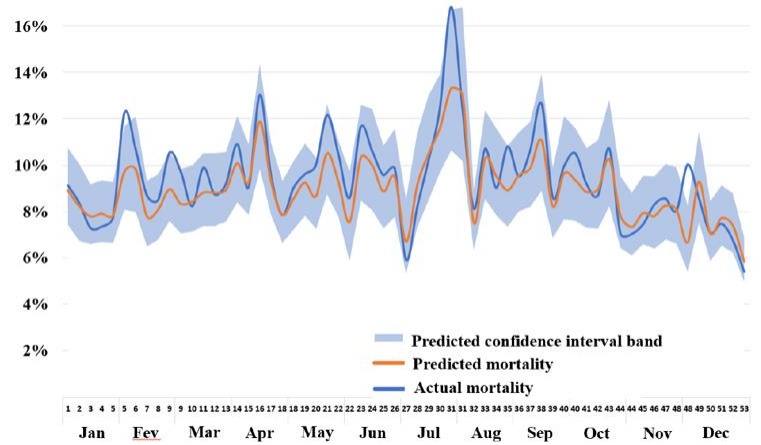
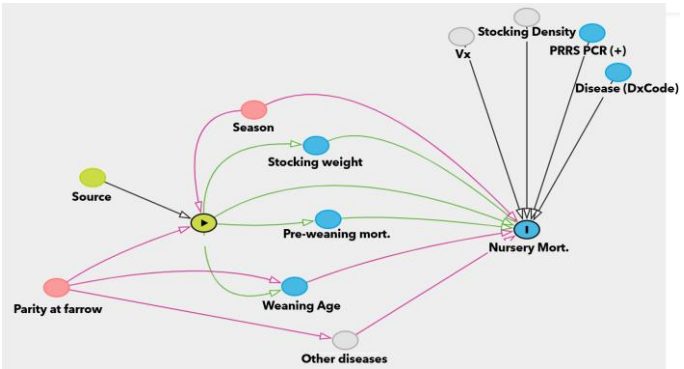
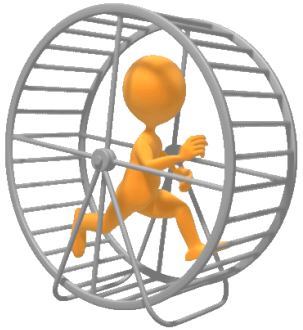
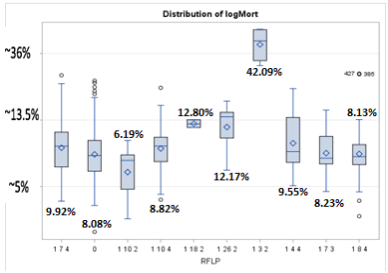
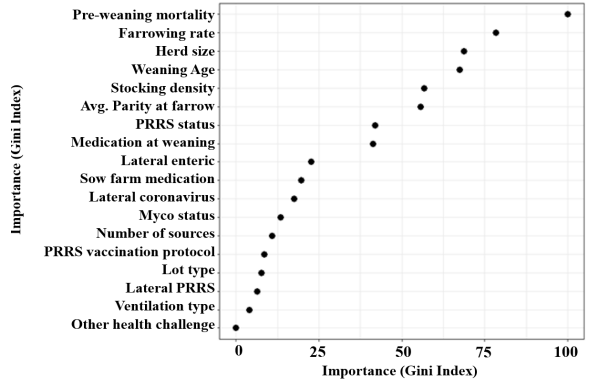
- Reveal the major drivers of swine performance
- Causal effect of important selected factors
- Forecast productivity of recently weaned pig flows











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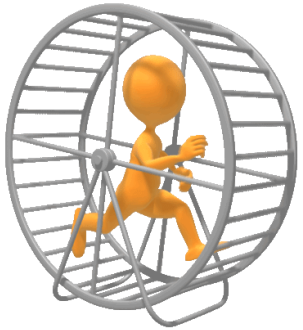
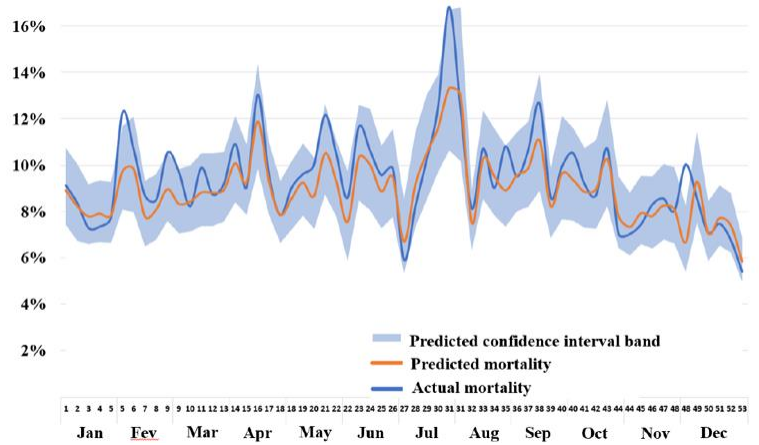
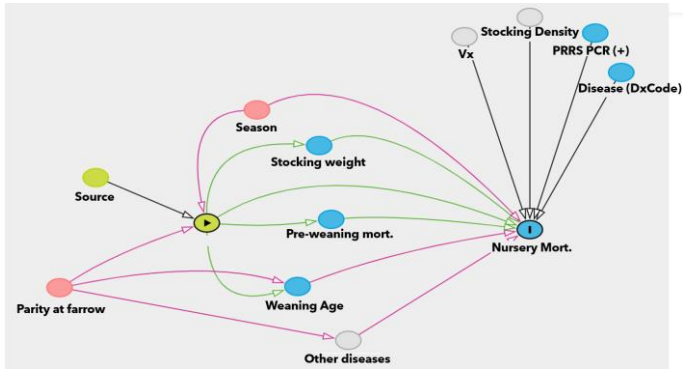




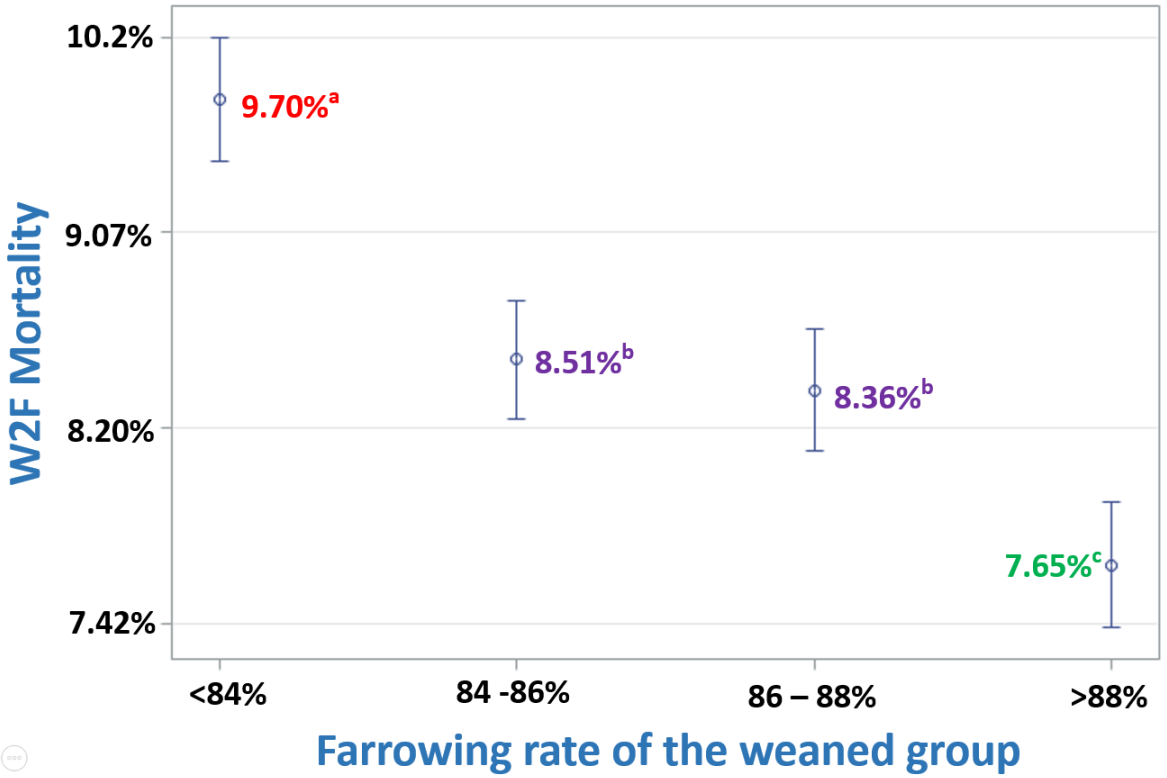


Materials and Methods

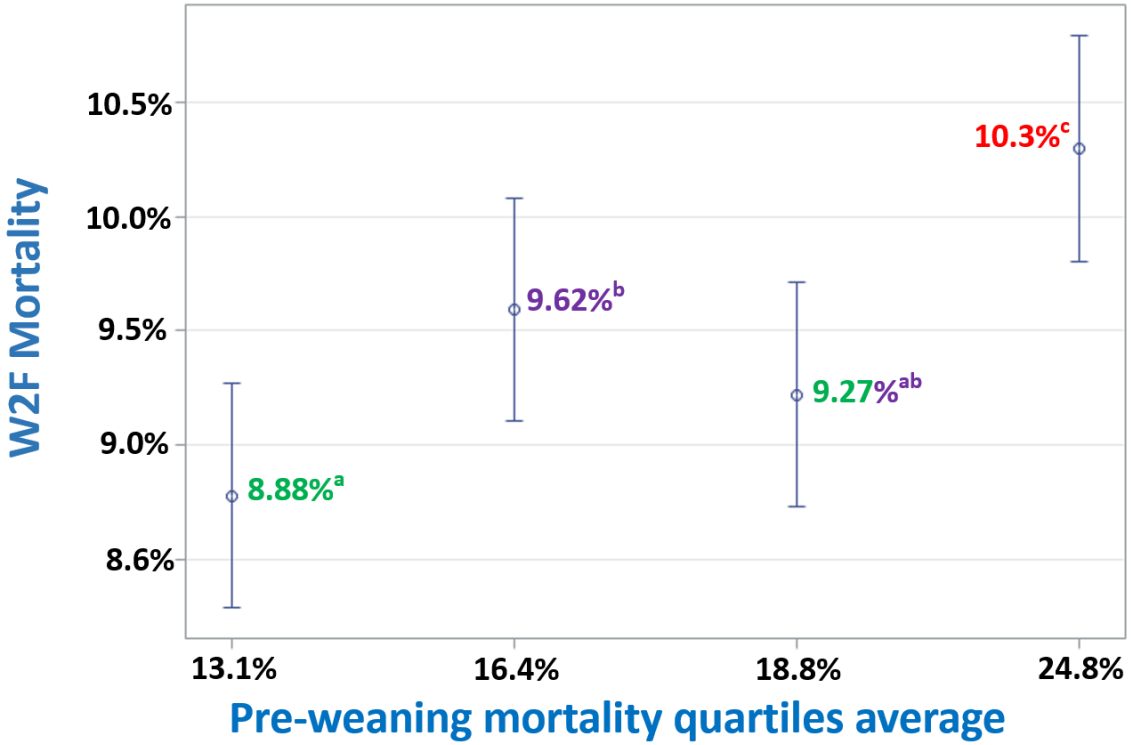
- Finisher closeouts (n=2568).
- Finisher groups marketed between **April 2018 – July 2020**
    - Breeding-to-wean (BTW) productivity parameters
    - BTW health status
    - PCR positive results for nursery and finishers groups
    - DxCode → Tissue submission to the VDL:
    - Pig flow and management factors
    - Closeout data of growing pig lots
    - Carcass information

Sow farm importance on downstream mortality

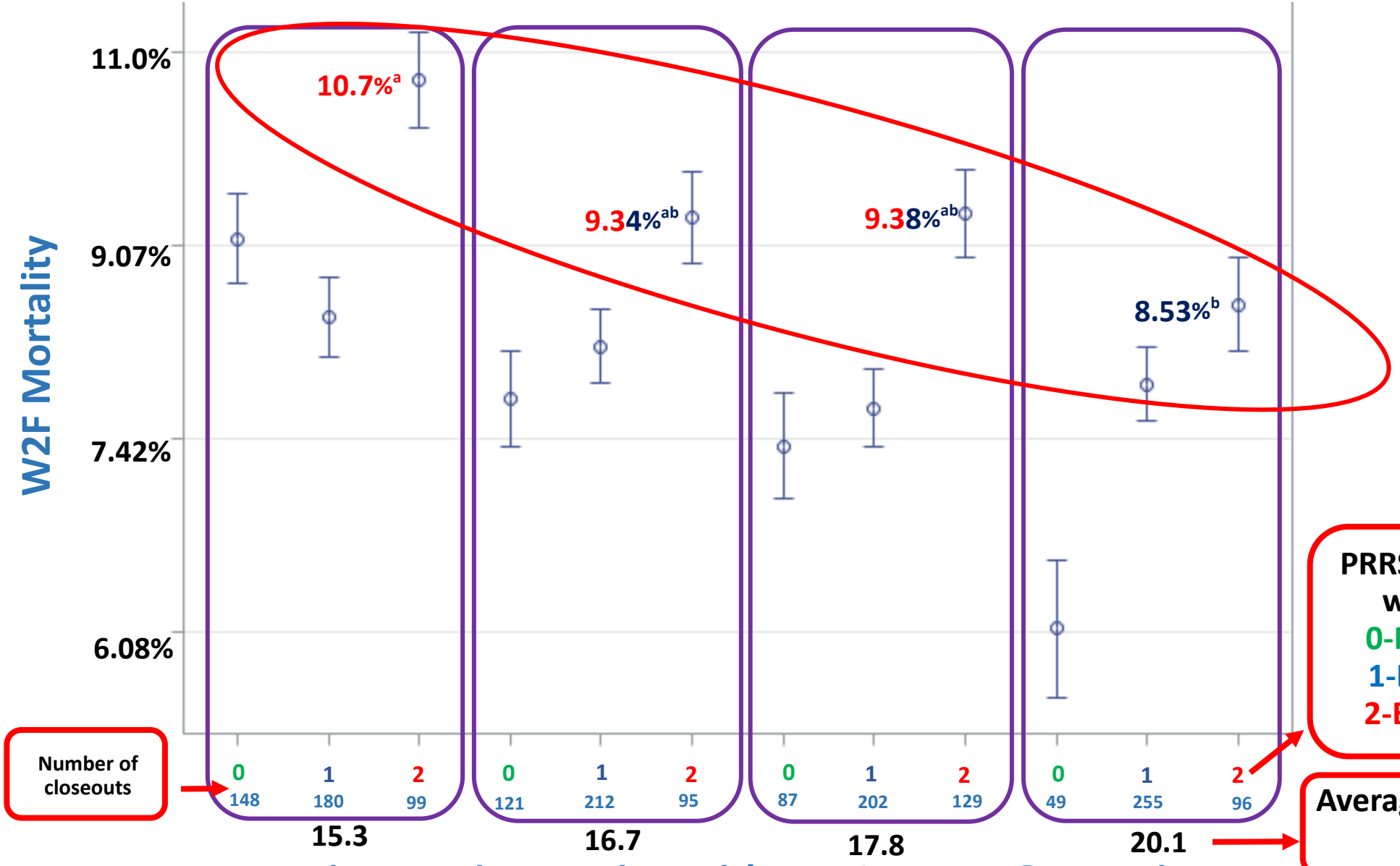
↑ Farrowing rate associated with ↓W2F mortality



↑ Pre-weaning mortality e associated with ↓W2F mortality



Acutely PRRSv-infected herds: ↑ W2F mortality all ages



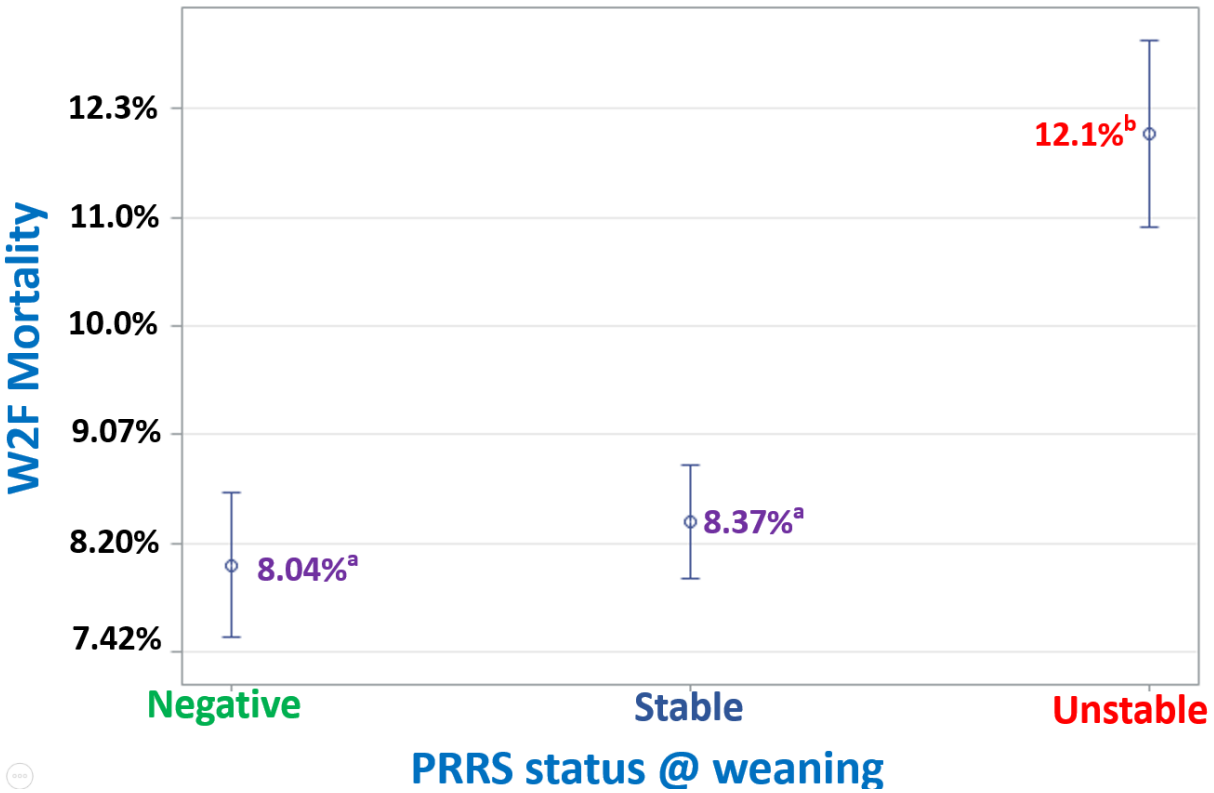
Number of closeouts

PRRS status @ weaning
0-Negative
1-Endemic
2-Epidemic

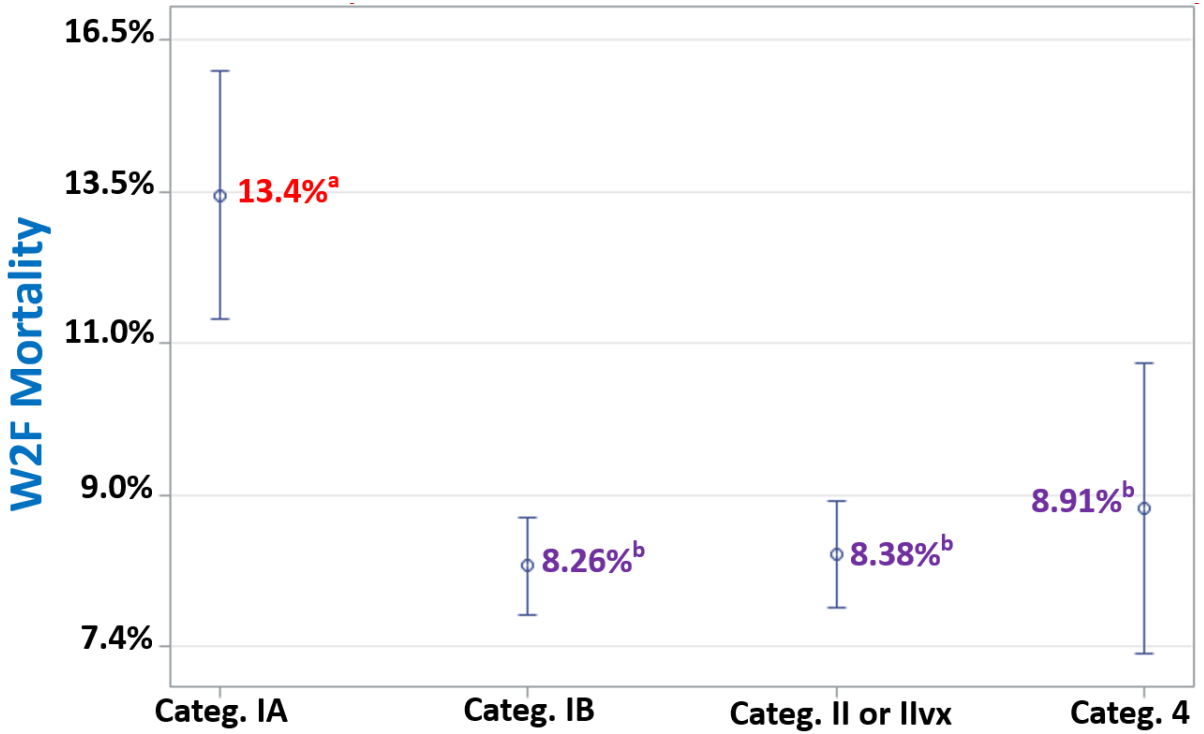
Average weaning age

Sow farm health importance on downstream mortality

PRRS unstable groups ↑ W2F mortality

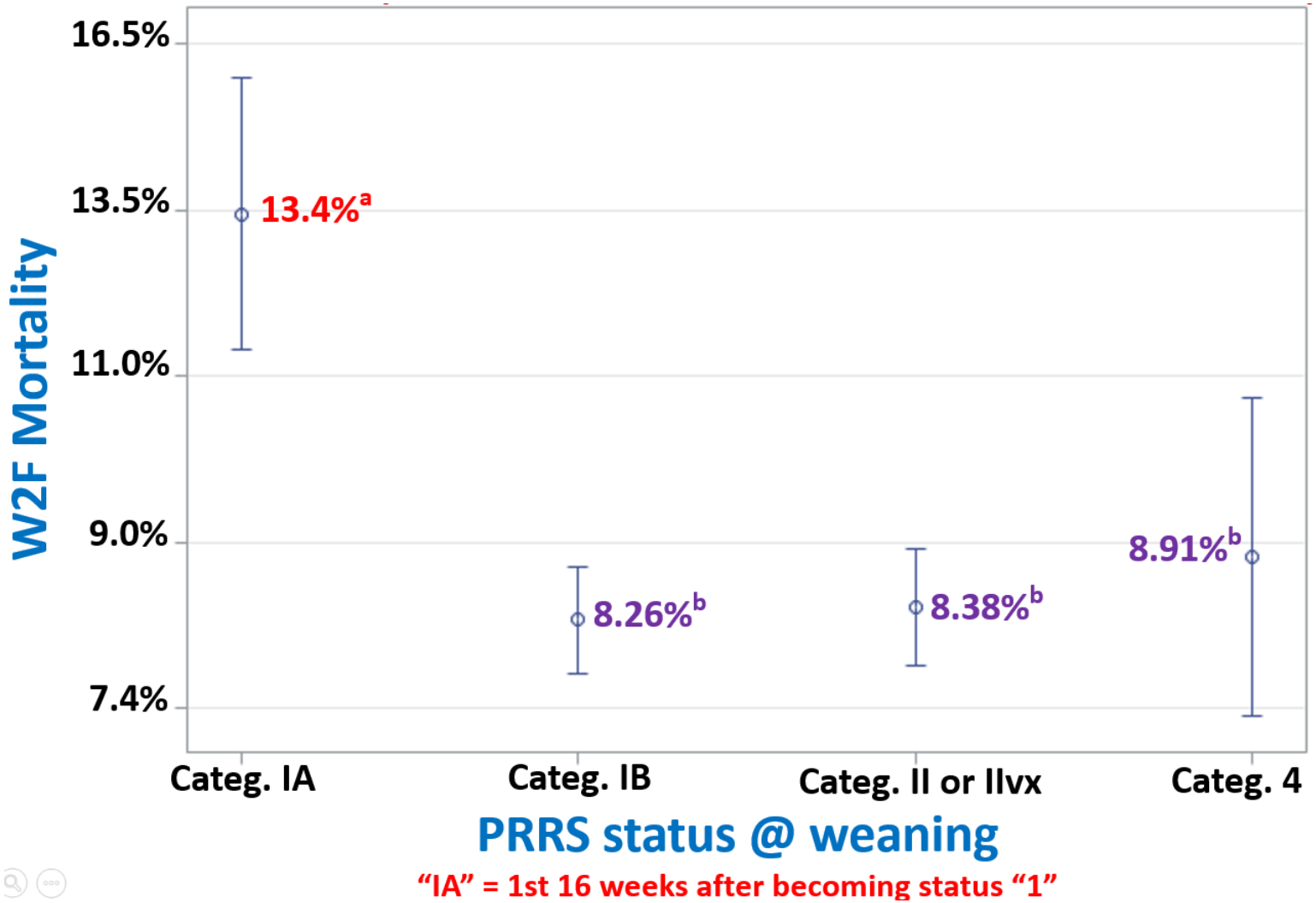


PRRS status equivalent to new "IA" - ↑ W2F mortality



"IA" = 1st 16 weeks after becoming status "1"

PRRS status equivalent to new "IA" - ↑ W2F mortality



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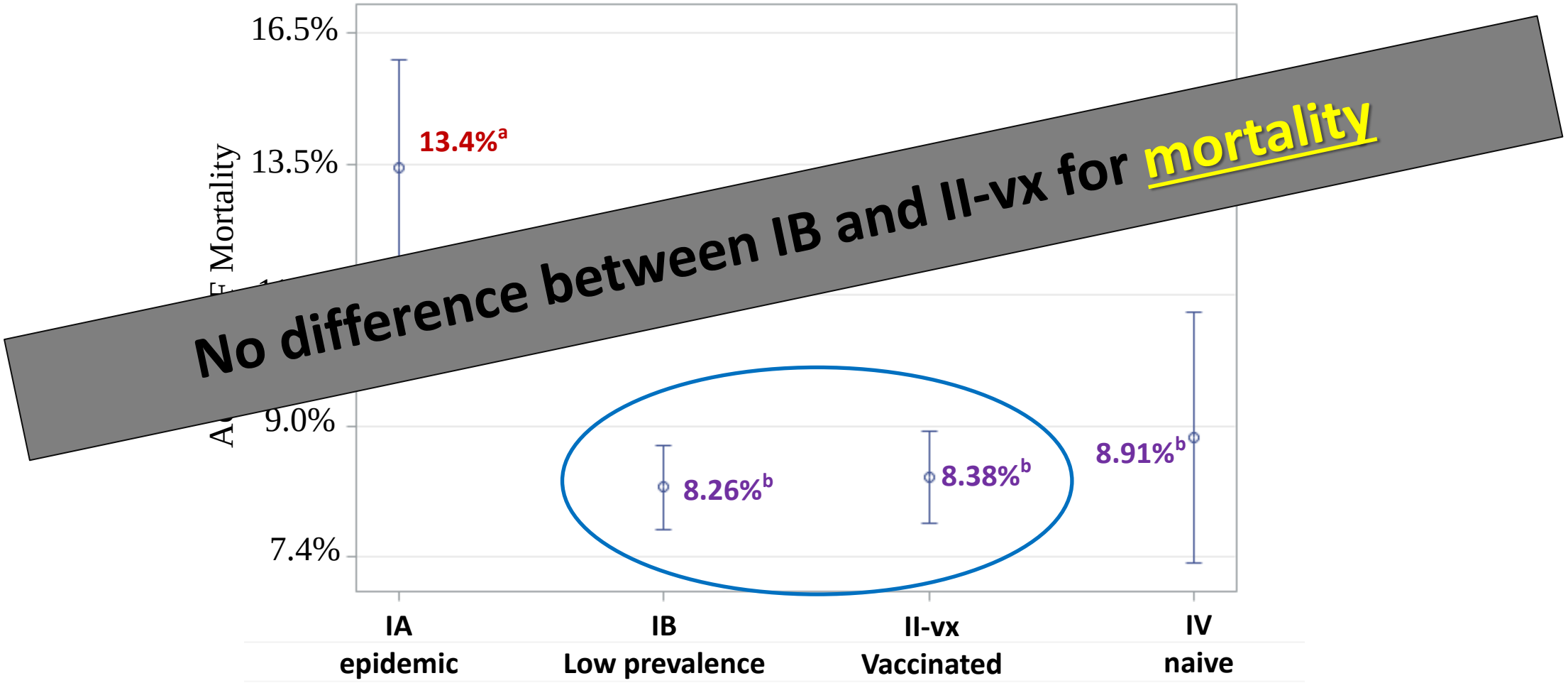
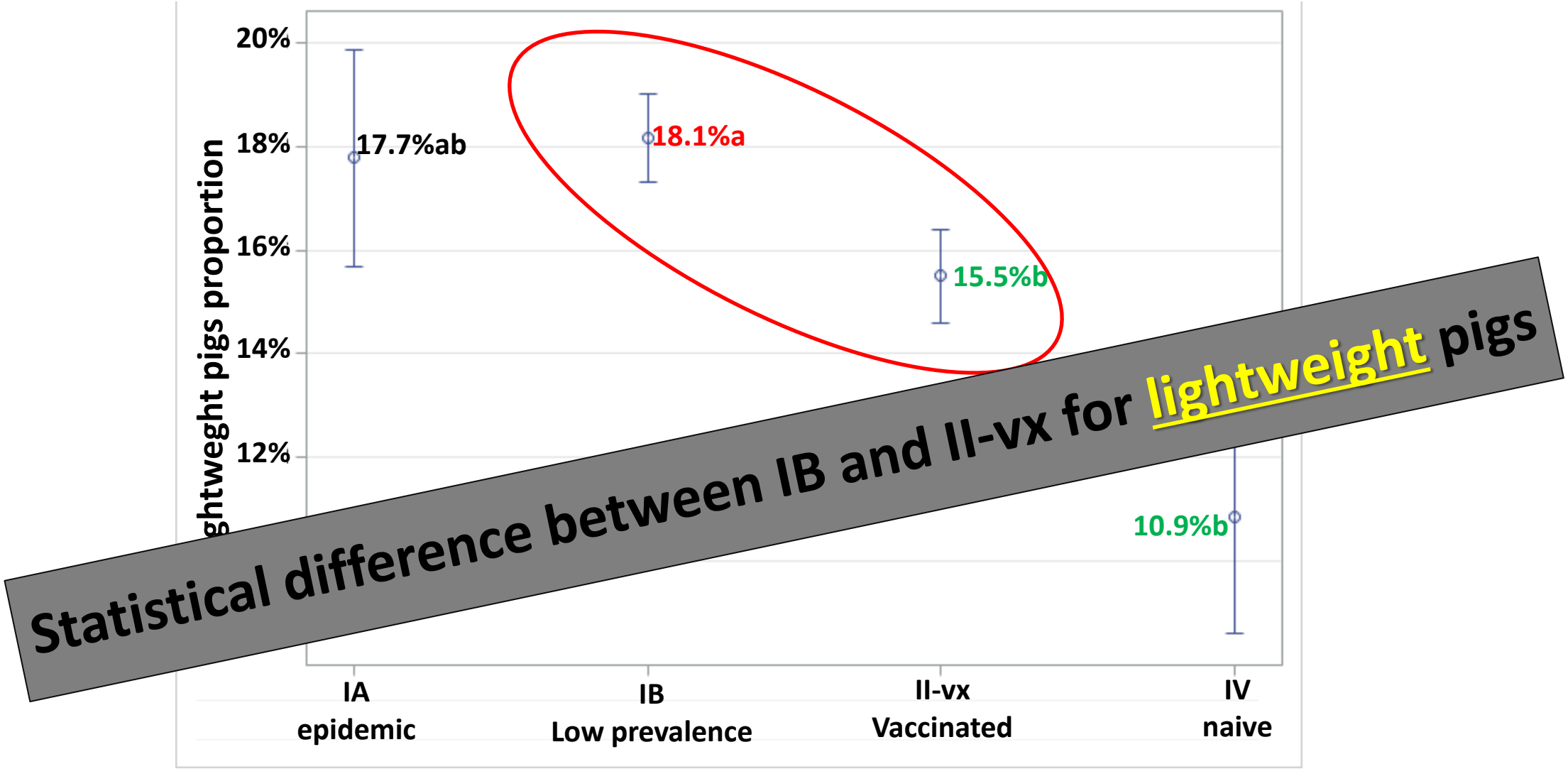
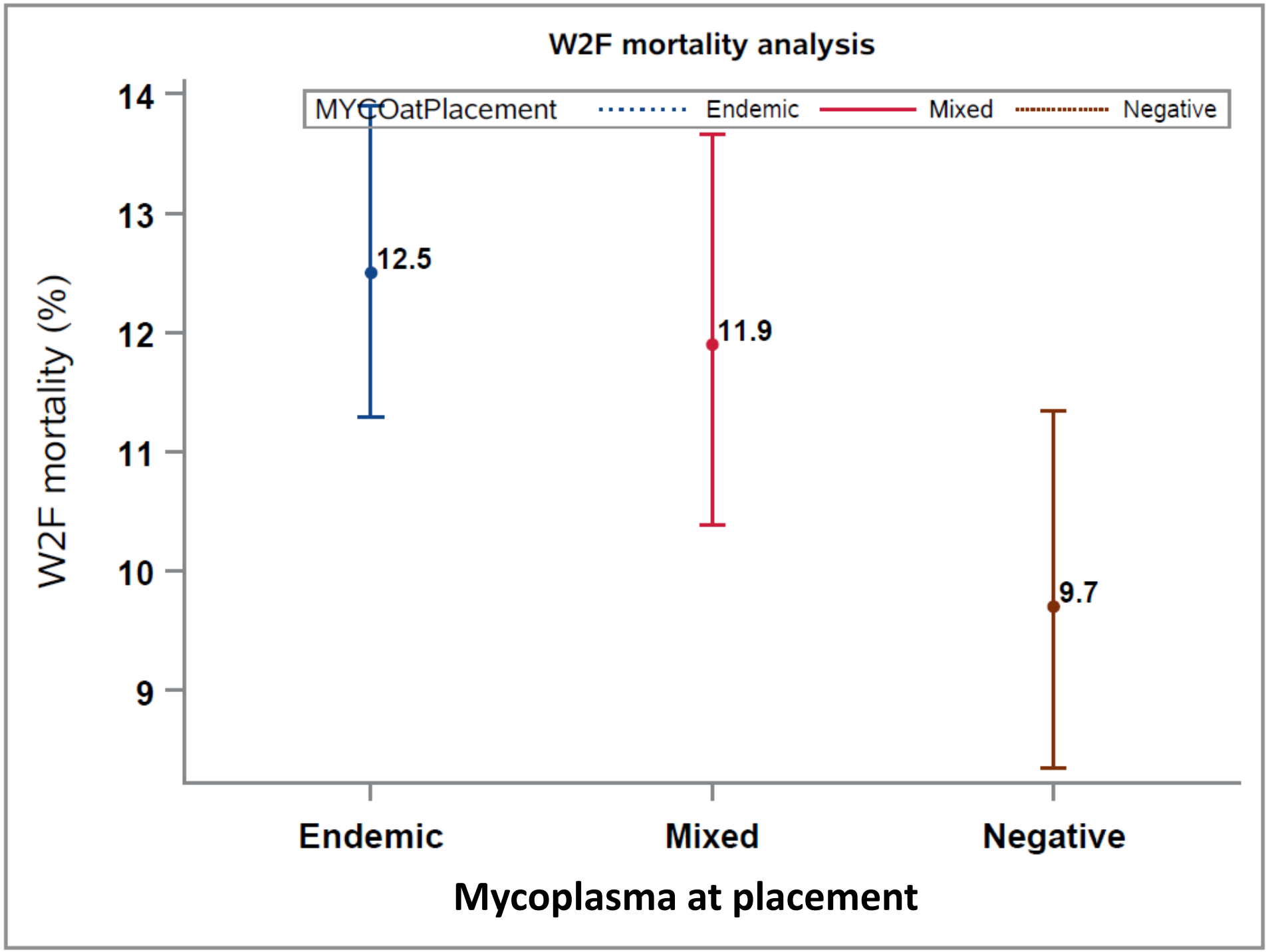
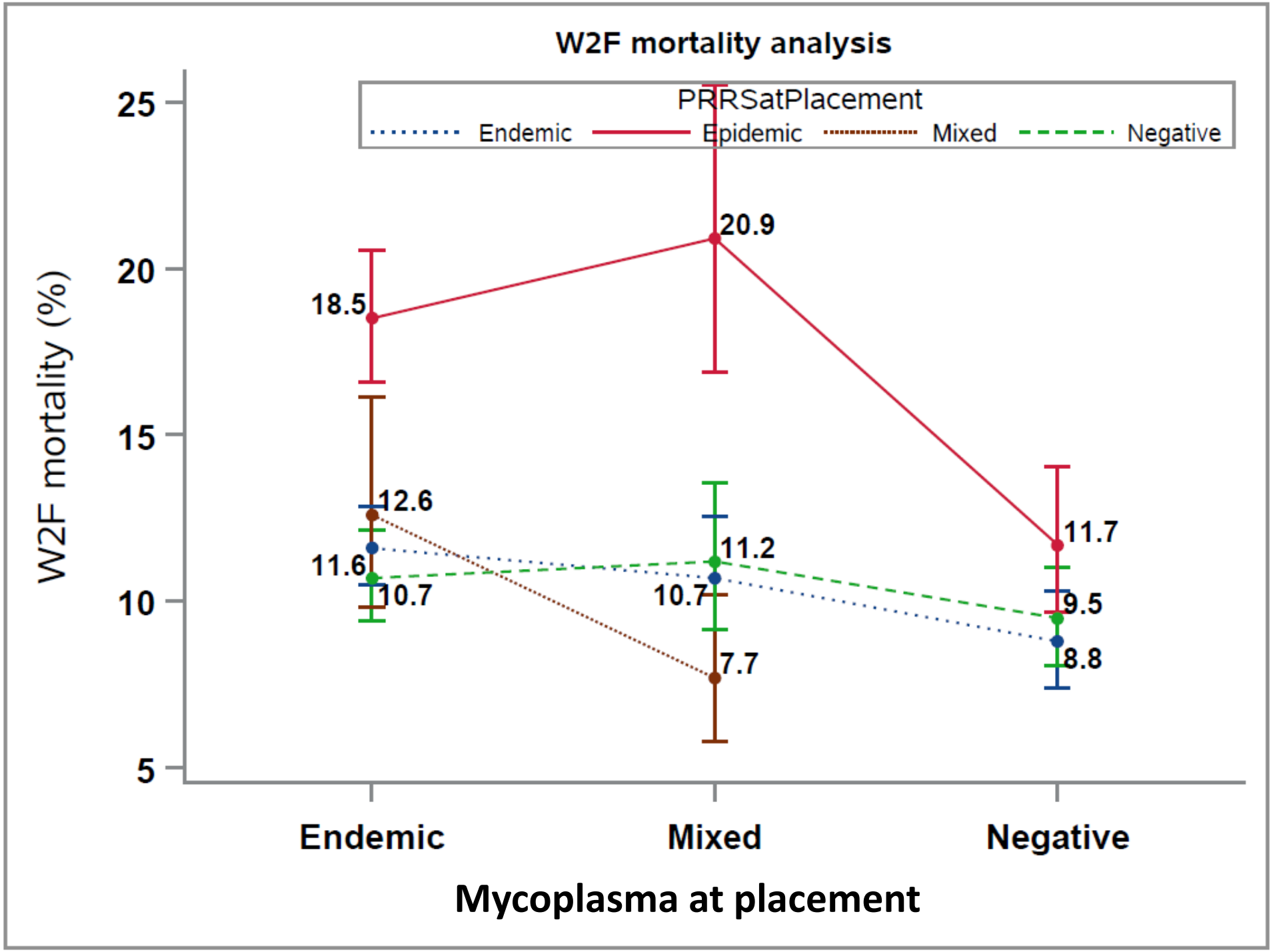


PRRS status equivalent to IA and IB - ↑ lightweight pigs




W2F mortality analysis
MYCOatPlacement
Endemic
Mixed
Negative
W2F mortality (%)
14
13
12
11
10
9
12.5
11.9
9.7
Endemic
Mixed
Negative
Mycoplasma at placement


W2F mortality analysis
PRRSatPlacement
Endemic
Epidemic
Mixed
Negative
W2F mortality (%)
25
20
15
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5
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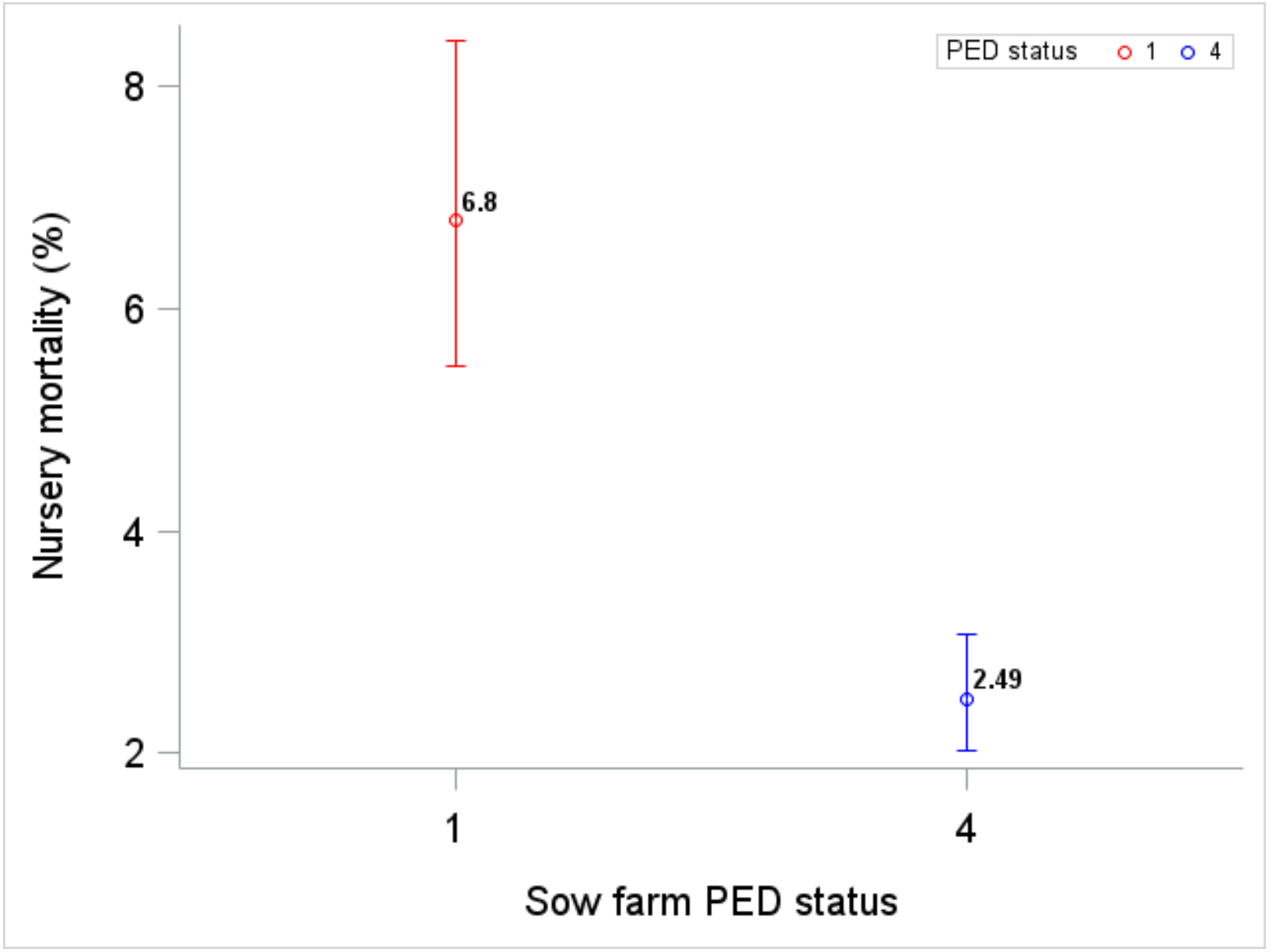
20.9
11.7
12.6
11.6
10.7
11.2
10.7
9.5
7.7
8.8
Endemic
Mixed
Negative
Mycoplasma at placement

PEDV importance on downstream mortality

PED groups weaned after the outbreak had higher nursery mortality

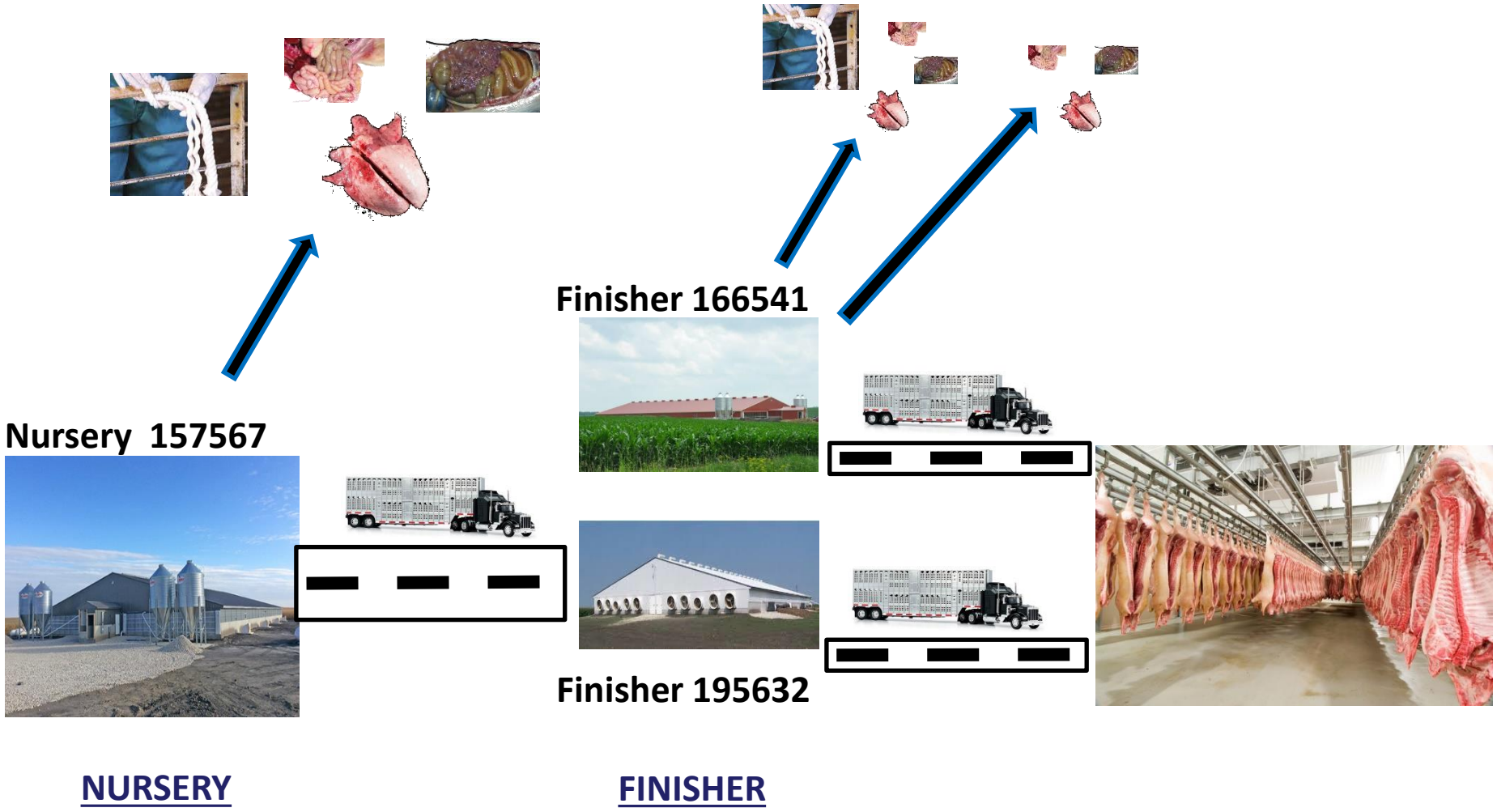


PED status 1: Epidemic

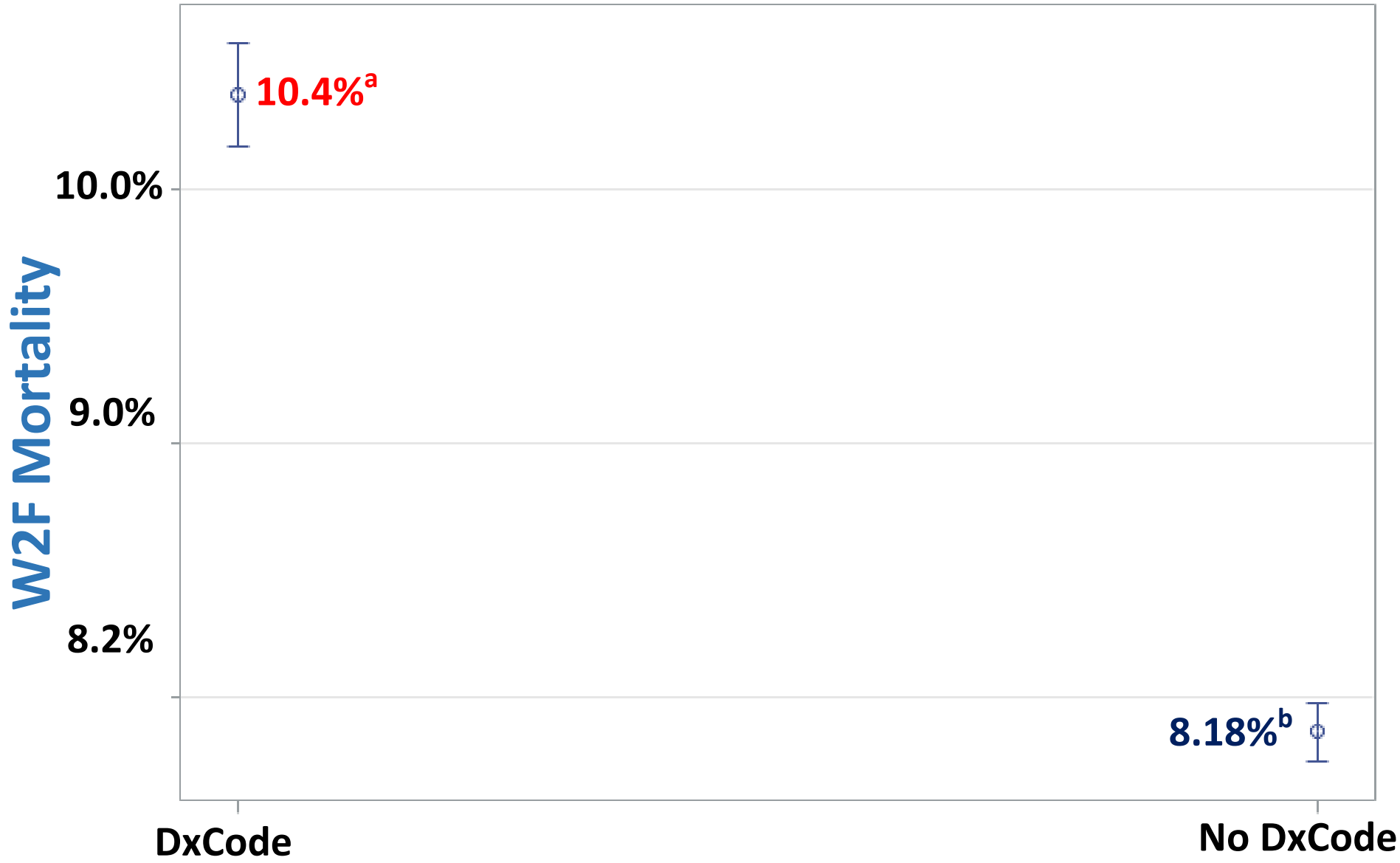
PED status 2: Naïve

Dx Codes importance on downstream mortality

Integrating Diagnostics (DxCode data)

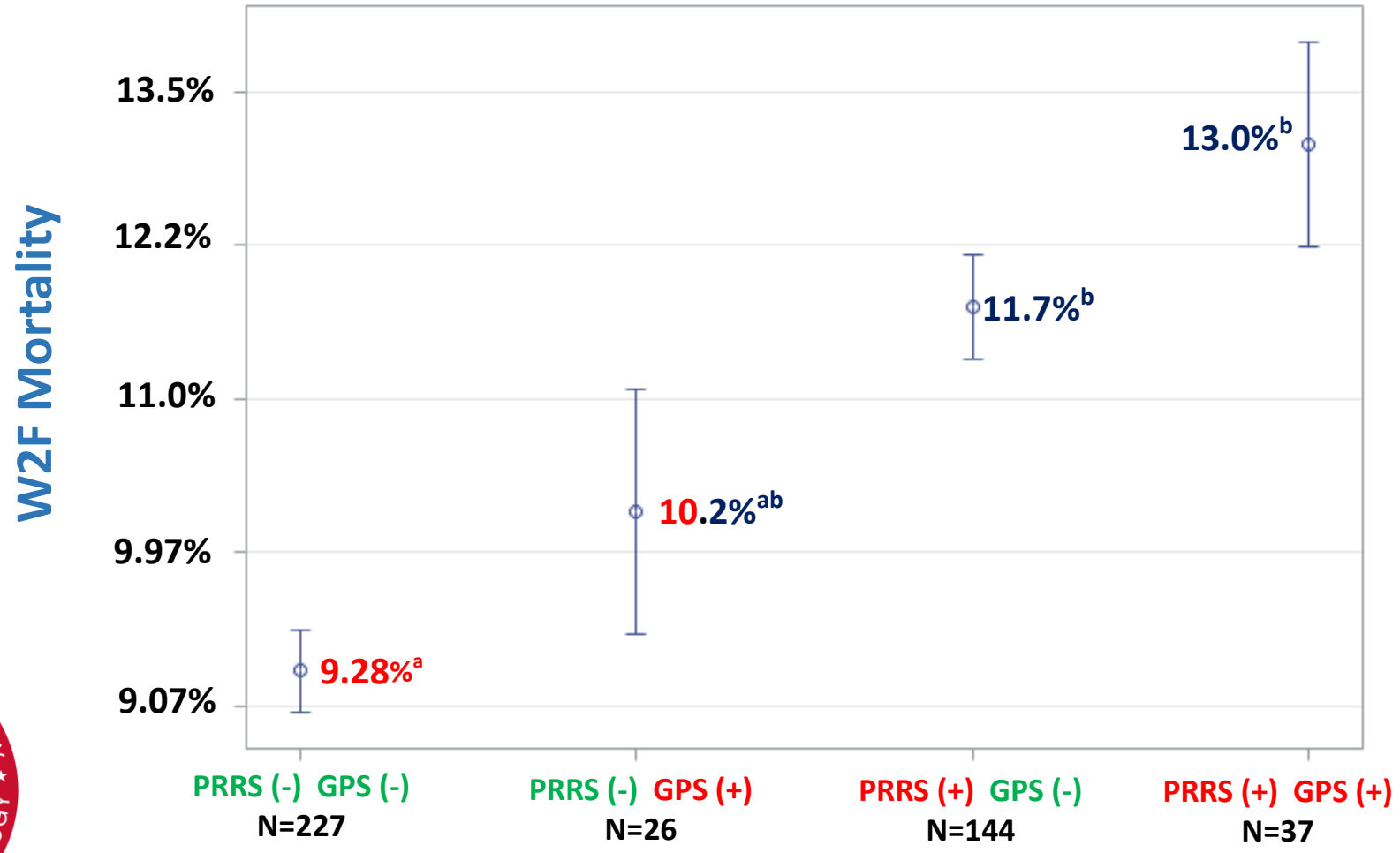


Closeouts with DxCodes assigned had ↑ W2F mortality



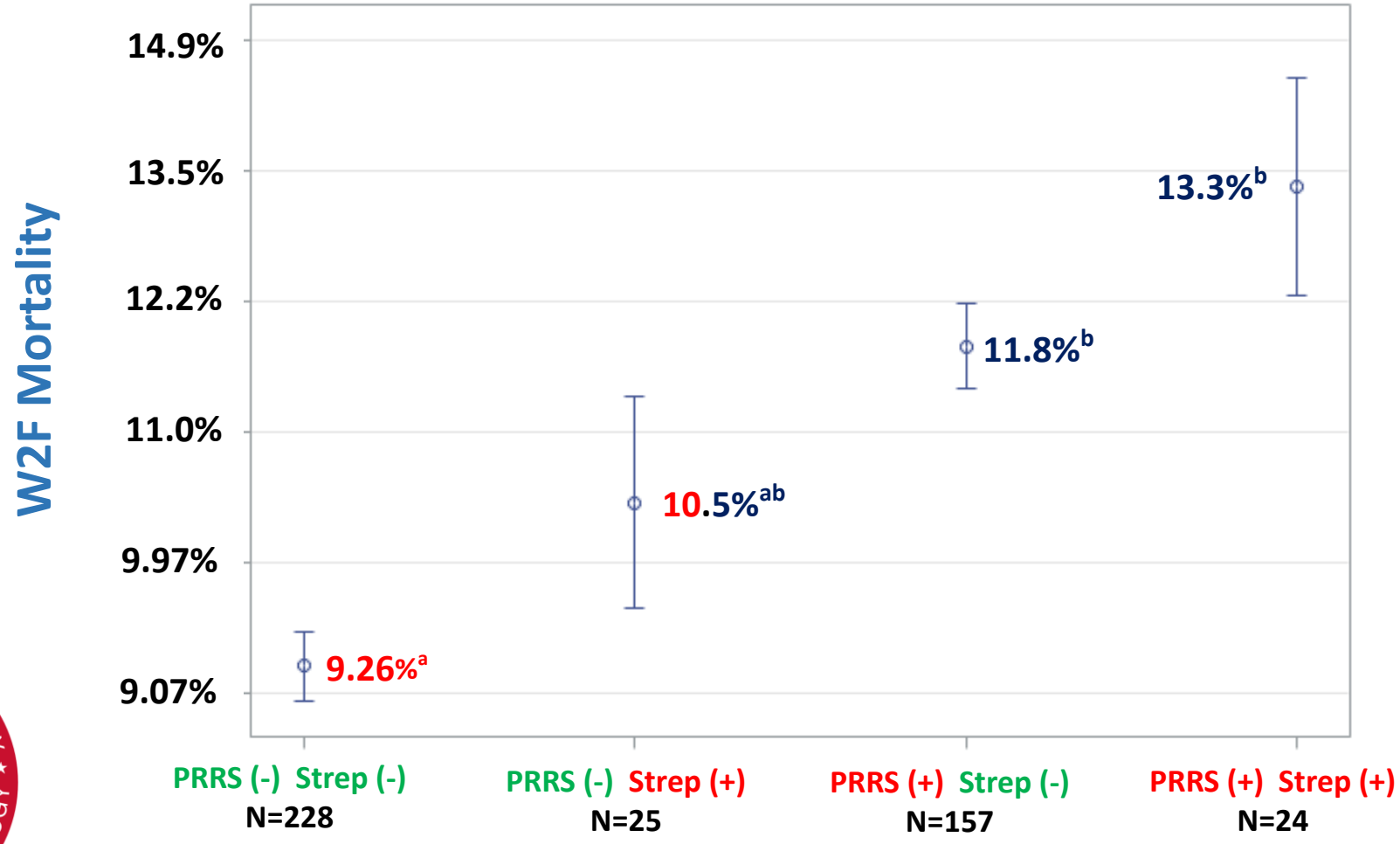
Closeouts with DxCode assigned during the growing phase

GPS diagnosed along with PRRS had higher W2F mortality



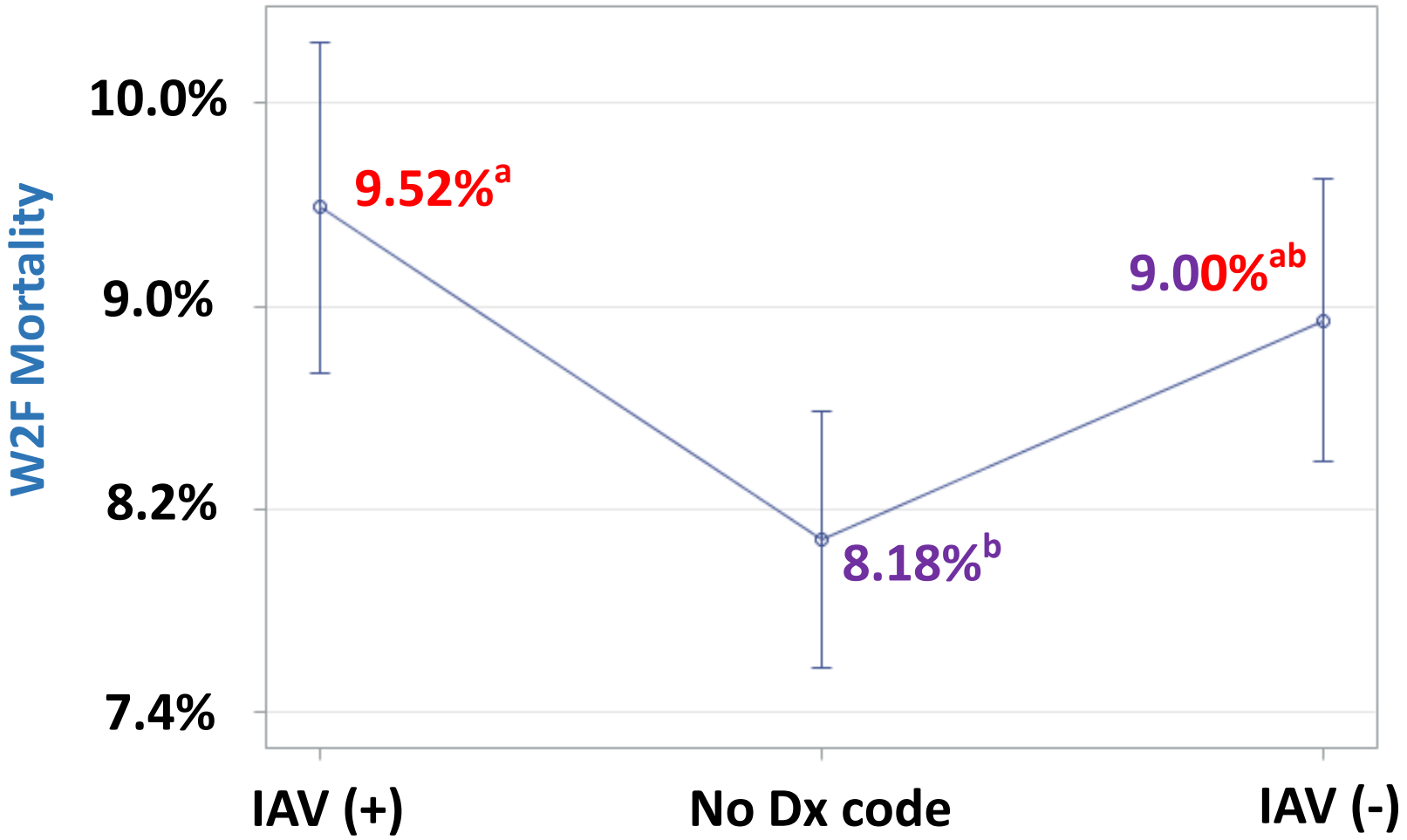
(+) or (-) groups for PRRSV and GPS

Strep. suis diagnosed along with PRRS had higher W2F mortality



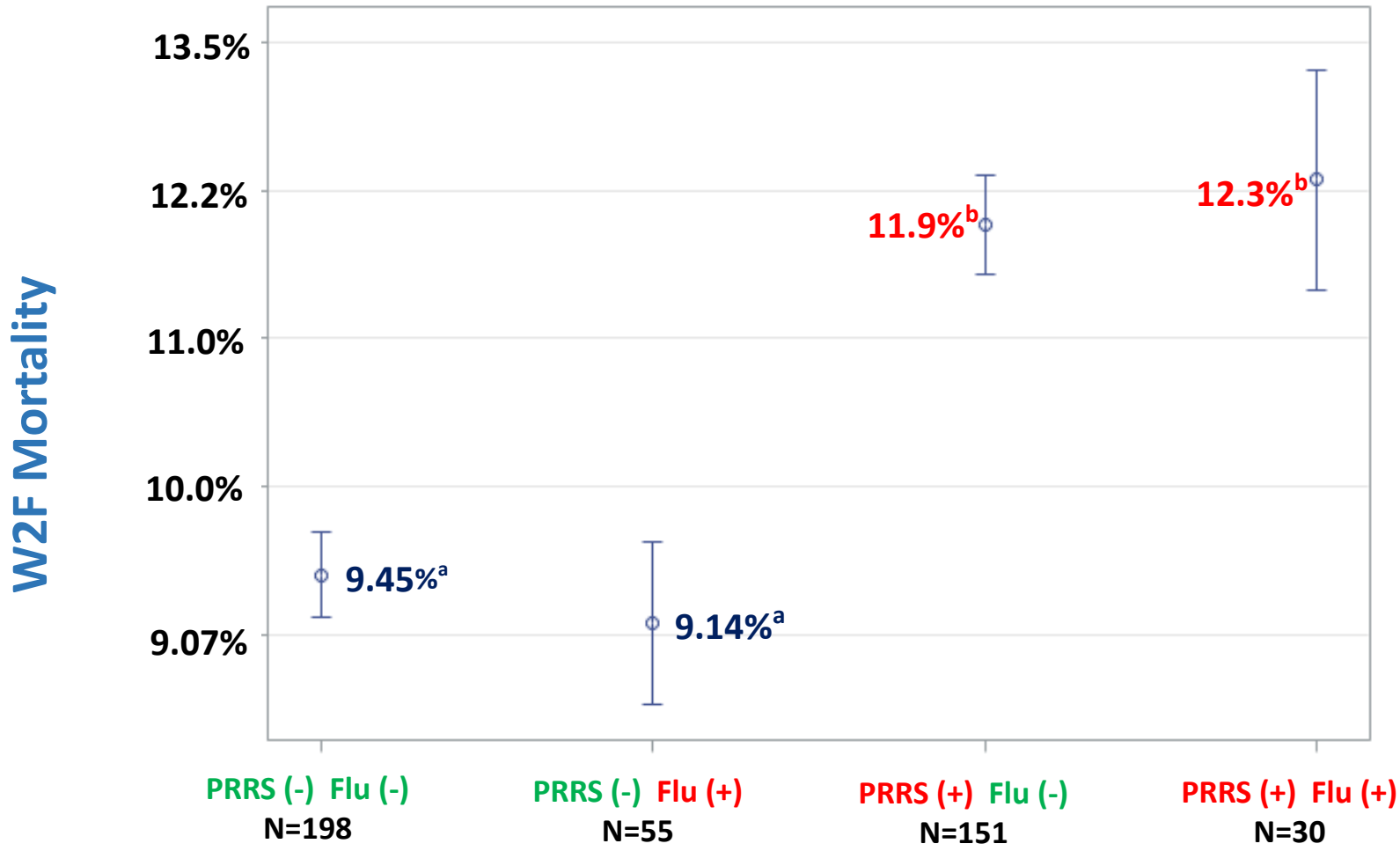
(+) or (-) groups for PRRSV and HPS

Closeouts with IAV DxCodes: ↑ W2F mortality



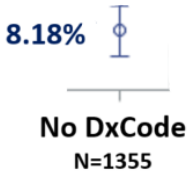
IAV effect on mortality, right?

Influenza and PRRS DxCodes had higher W2F mortality

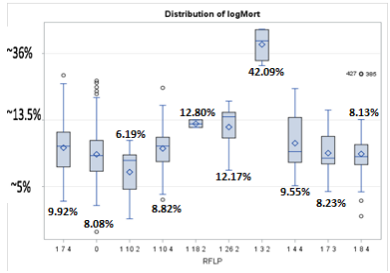


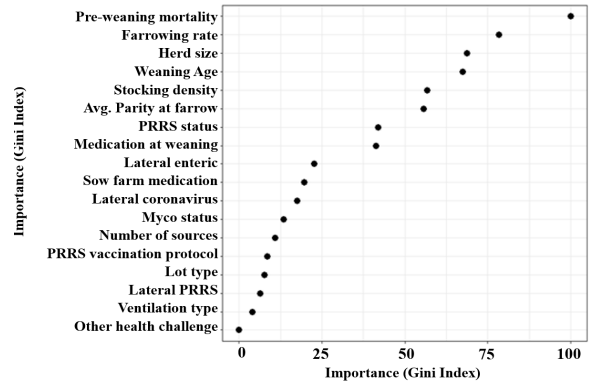
Interaction

- IAV was only important when w/ PRRSv

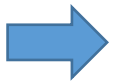


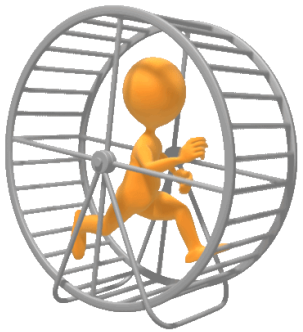
Closeouts with (+) or (-) DxCodes for PRRSV and Influenza





Master Table





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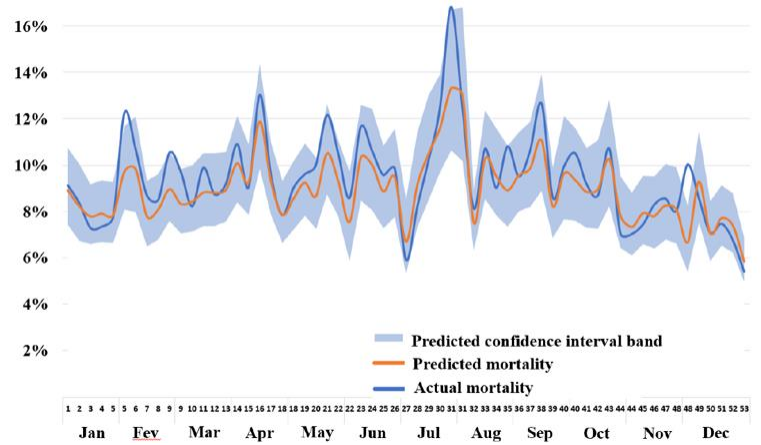
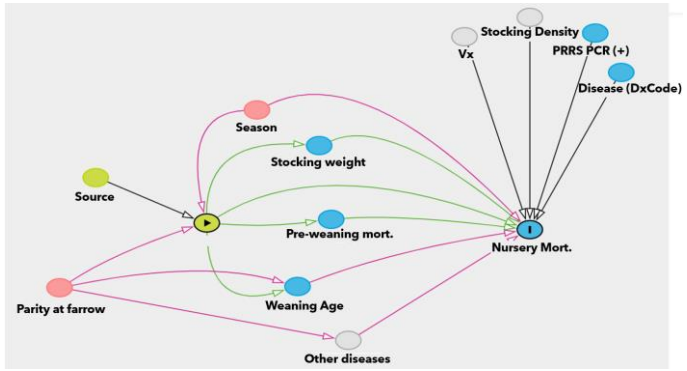
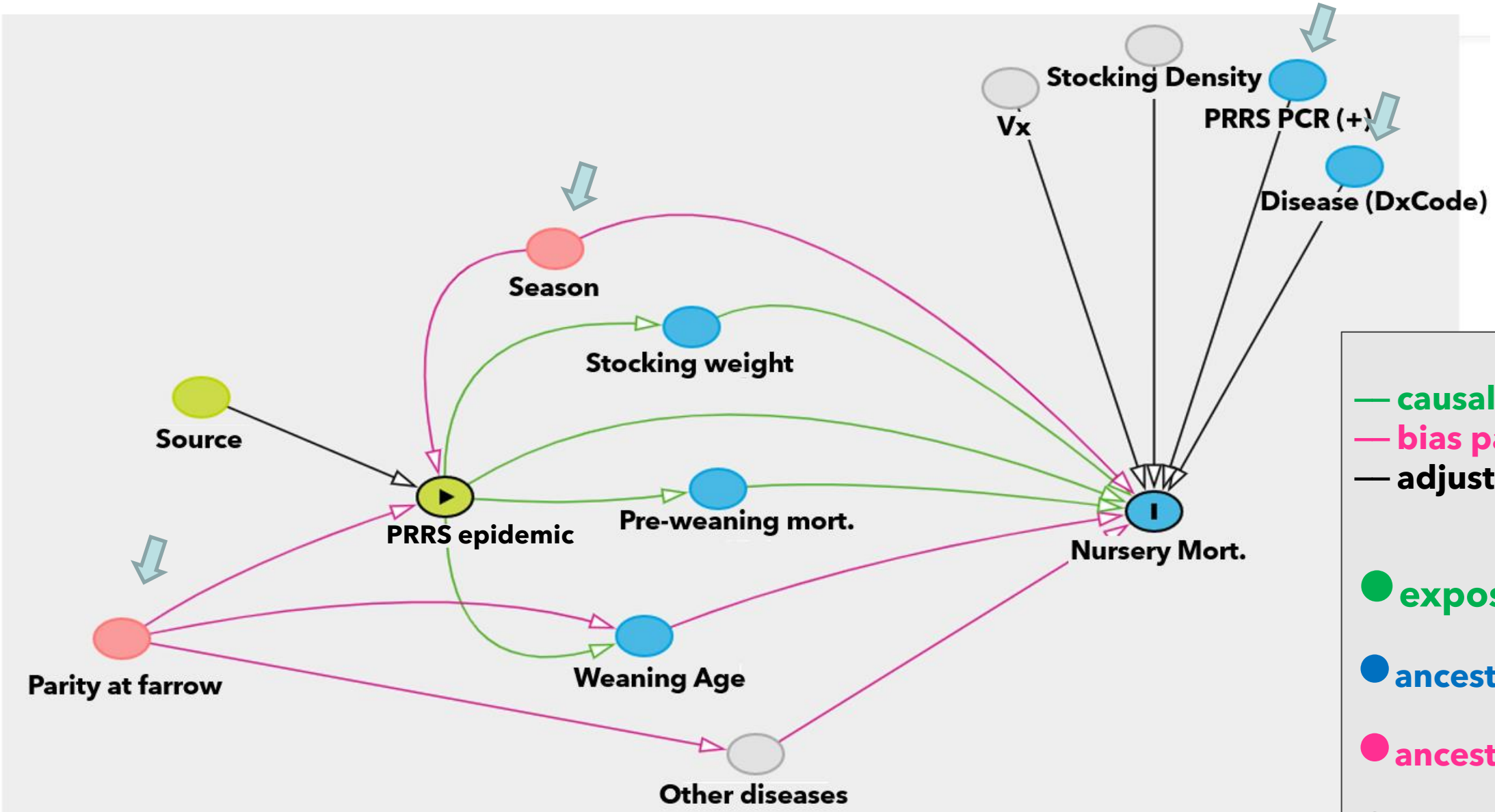




Example: Causal pathway PRRSv → Nursery mortality



Key:

— causal paths

— bias path

— adjusted

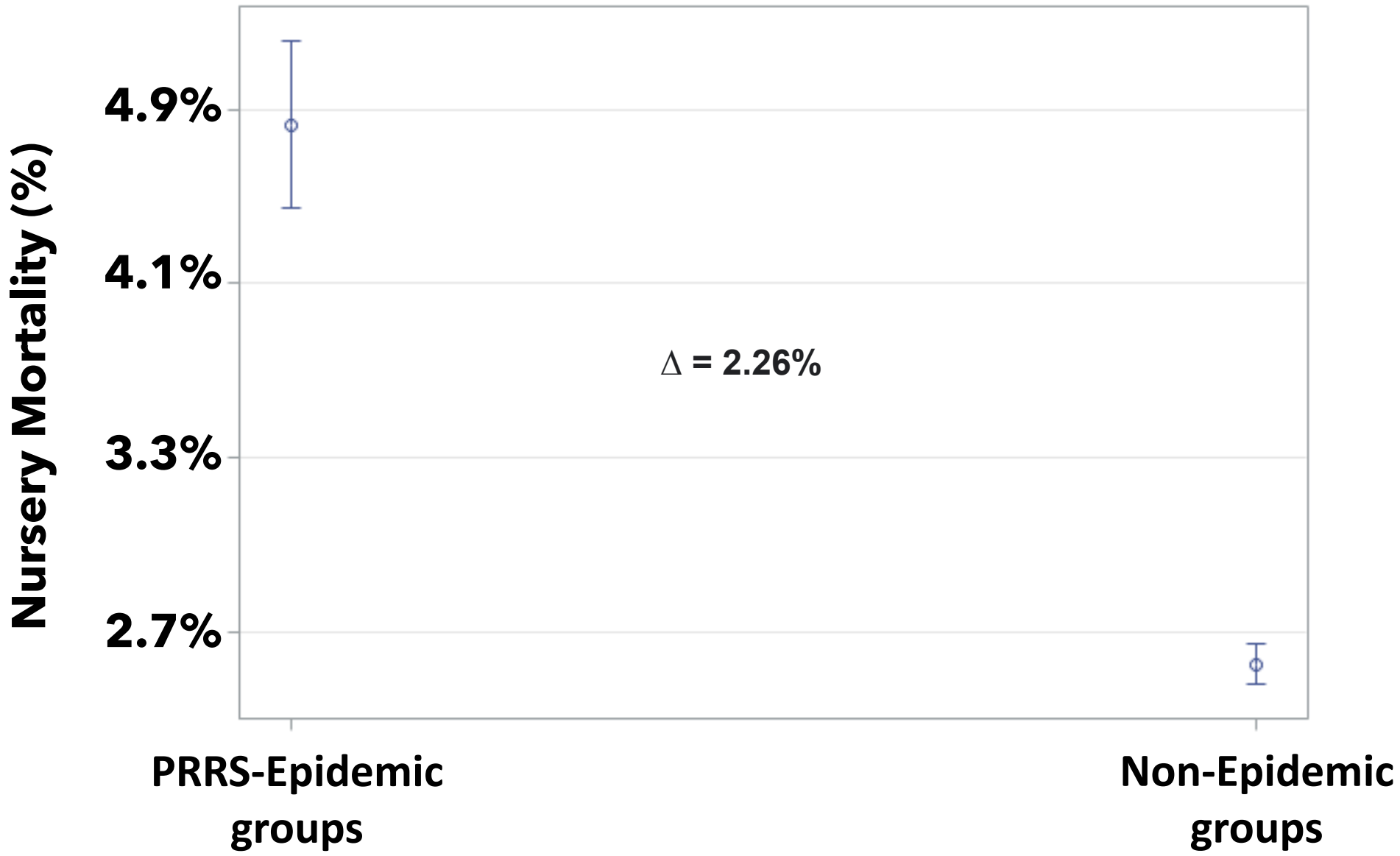
● exposure interest

● ancestor of outcome

● ancestor both exp/out

● unobserved data

Univariate analysis

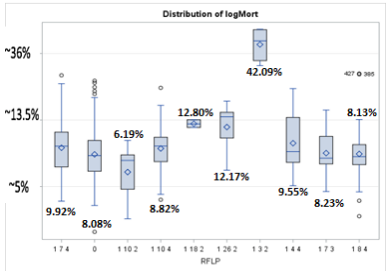


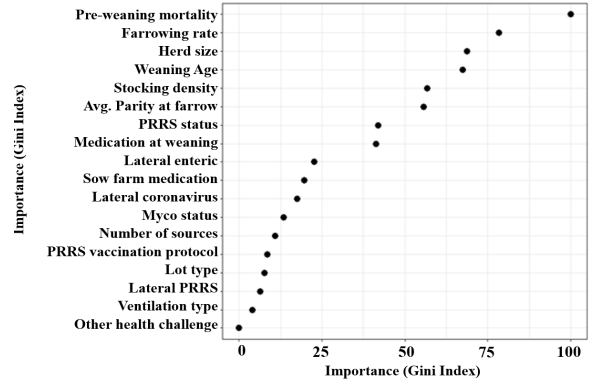
IPW – Inverse probability weighting (Doubly robust method)

Analysis of Causal Effect										
Parameter	Treatment Level	Estimate	Robust Std Err	Bootstrap Std Err	Wald 95% Confidence Limits		Bootstrap Wald 95% Confidence Limits		Z	Pr > |Z|
POM	Epidemic	-2.5259	0.1179	0.1124	-2.7571	-2.2948	-2.7461	-2.3057	-21.42	<.0001
POM	else	-3.6434	0.0234	0.0232	-3.6893	-3.5976	-3.6889	-3.5979	-155.83	<.0001
ATE		1.1175	0.1199	0.1153	0.8826	1.3524	0.8916	1.3435	9.32	<.0001
NOTE: 720 out of 1000 bootstrap samples are used to calculate standard errors.										

- Epidemic: 8.0%
- Non-epidemic: 2.6%

$\Delta = 5.38\%$





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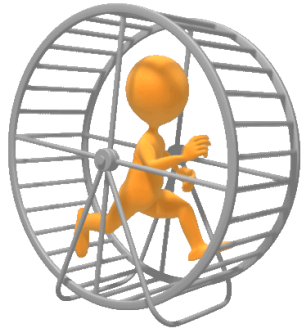
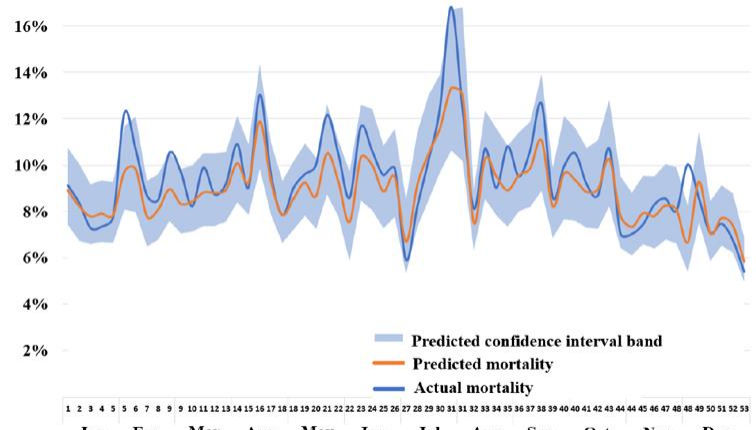
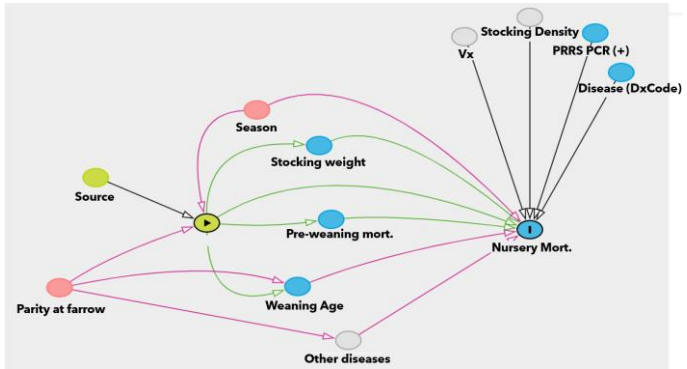


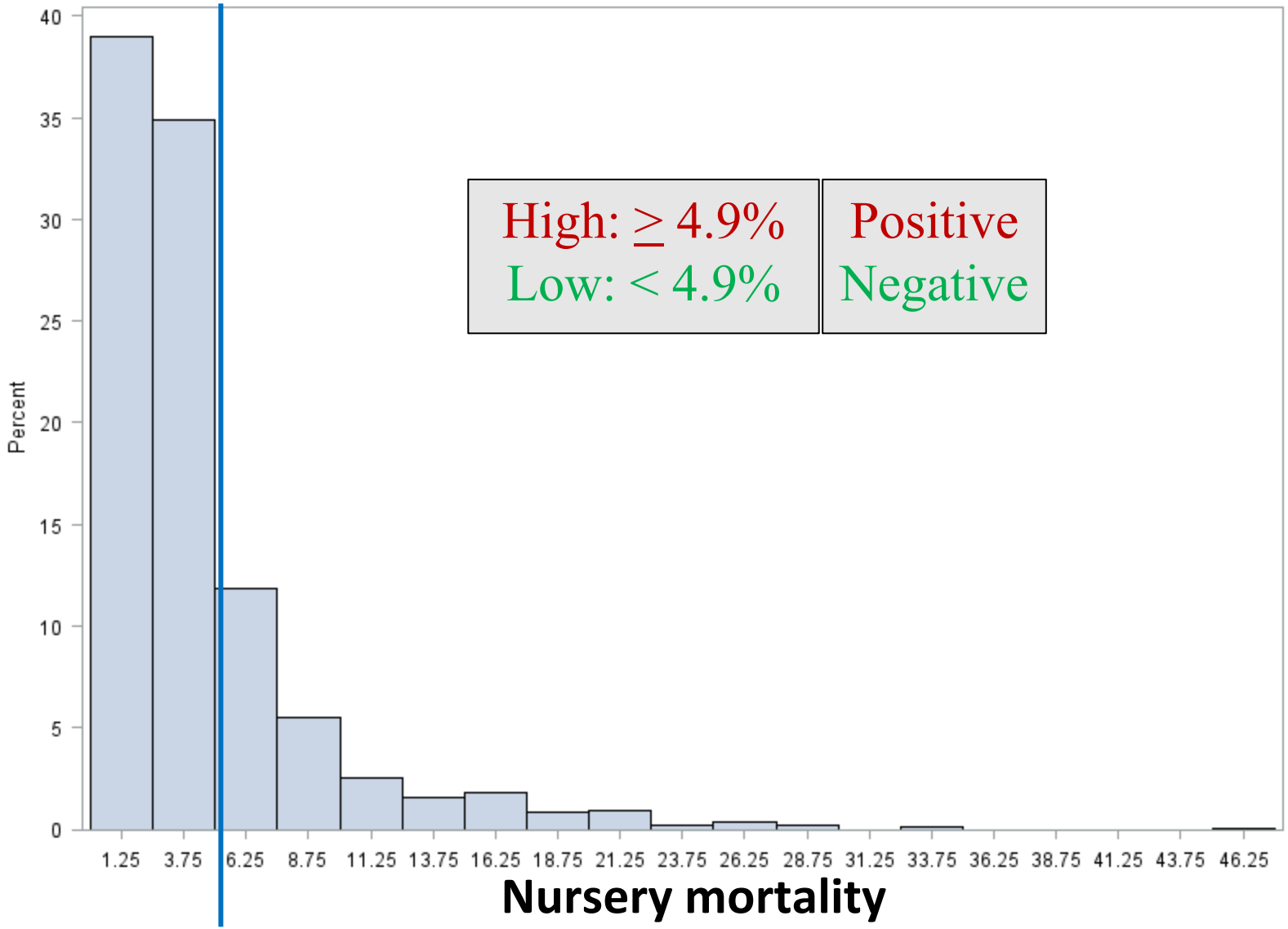




Forecasting groups with High or Low nursery mortality

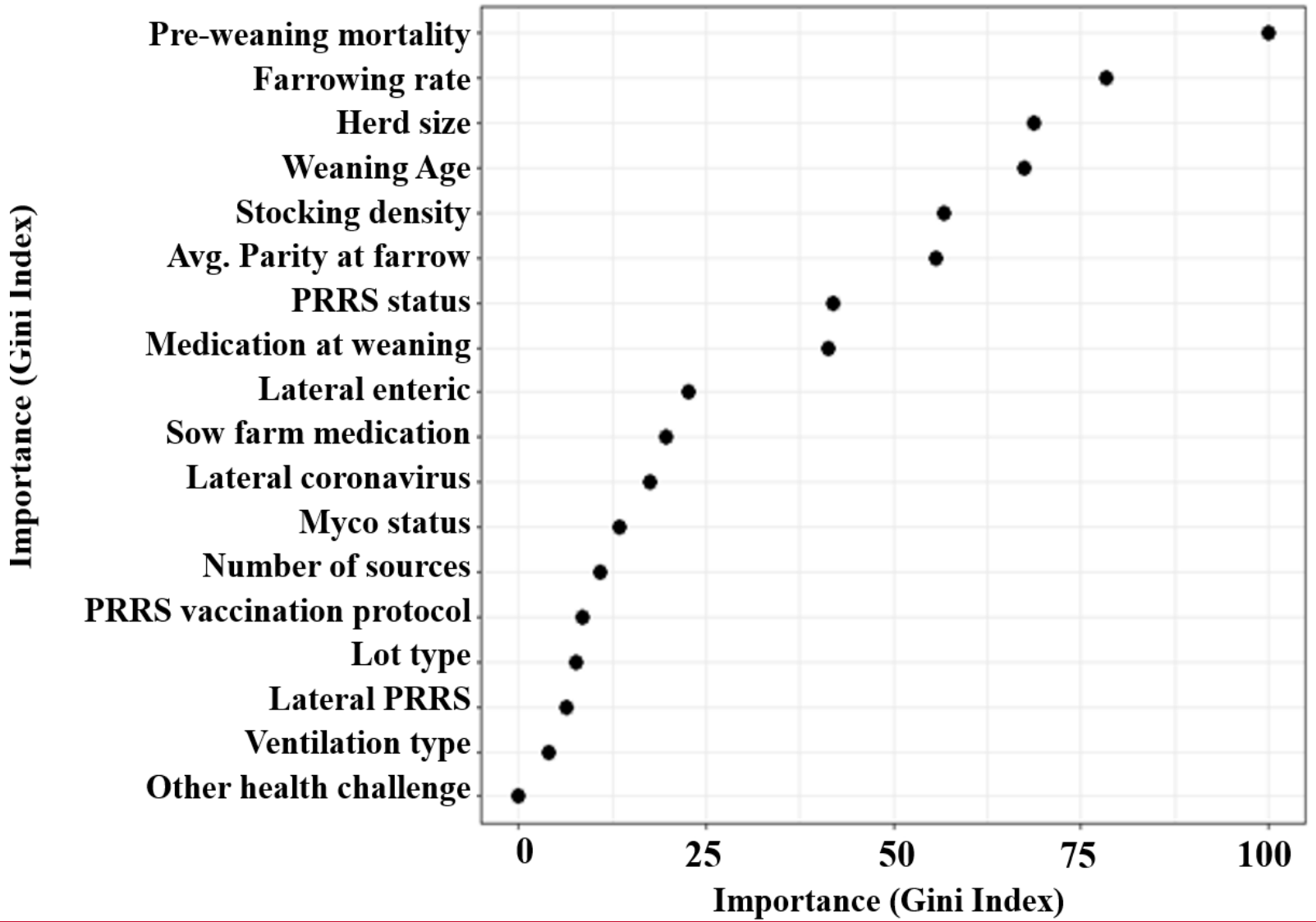
Forecasting nursery mortality:

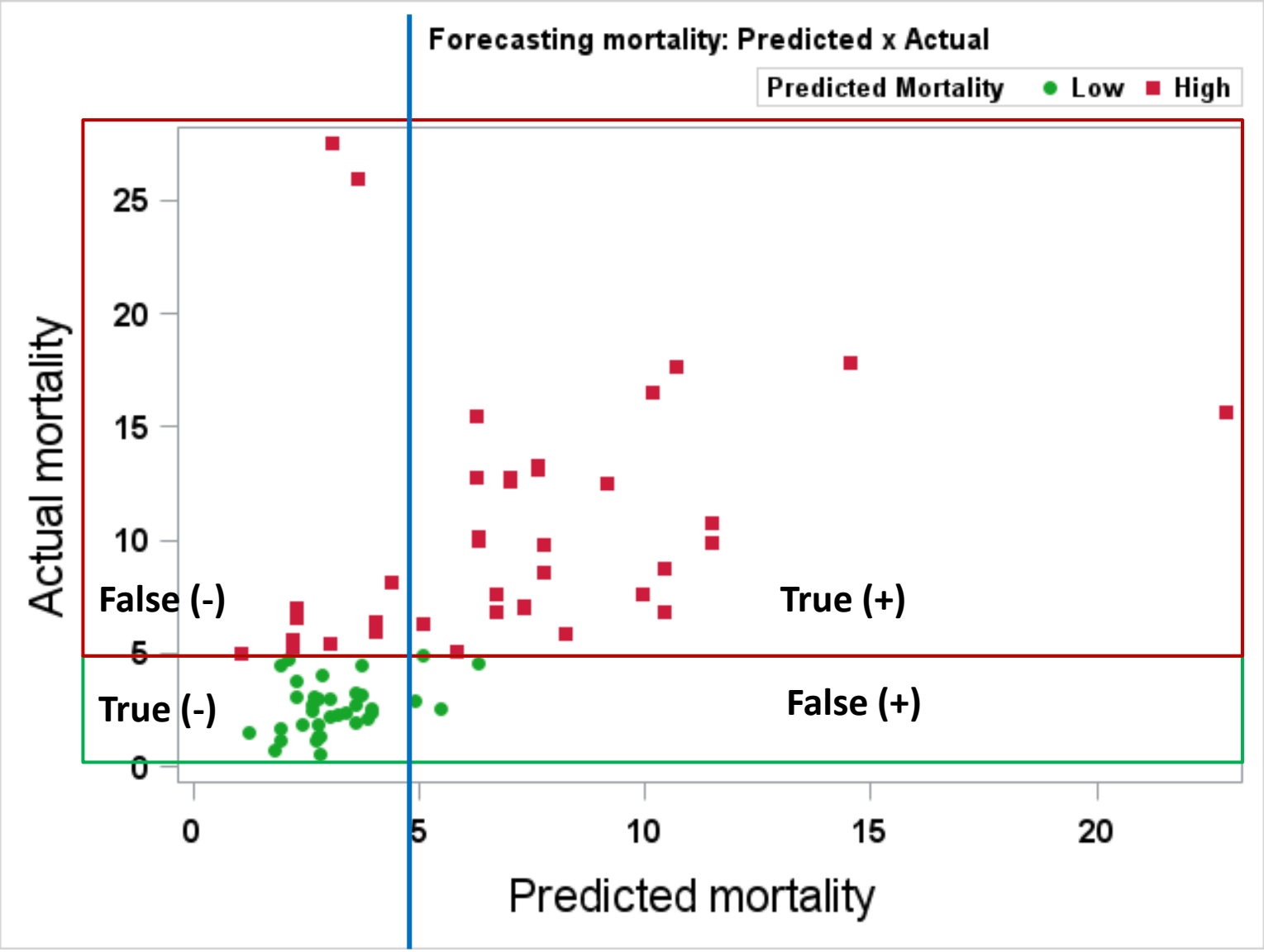
- *1st - Train the model*
  - *2 years of closeouts*
  - *Sow farm and stocking factors*
  - *Compare M.L models*
- *3rd – Ranking and scoring*
- *4th – Forecast in new data*



Ranking the predictors of high nursery mortality

- ***Identifying and ranking the drivers*** *of high nursery mortality for pigs raised under field conditions*





Forecasting performance

Accuracy:77.14%

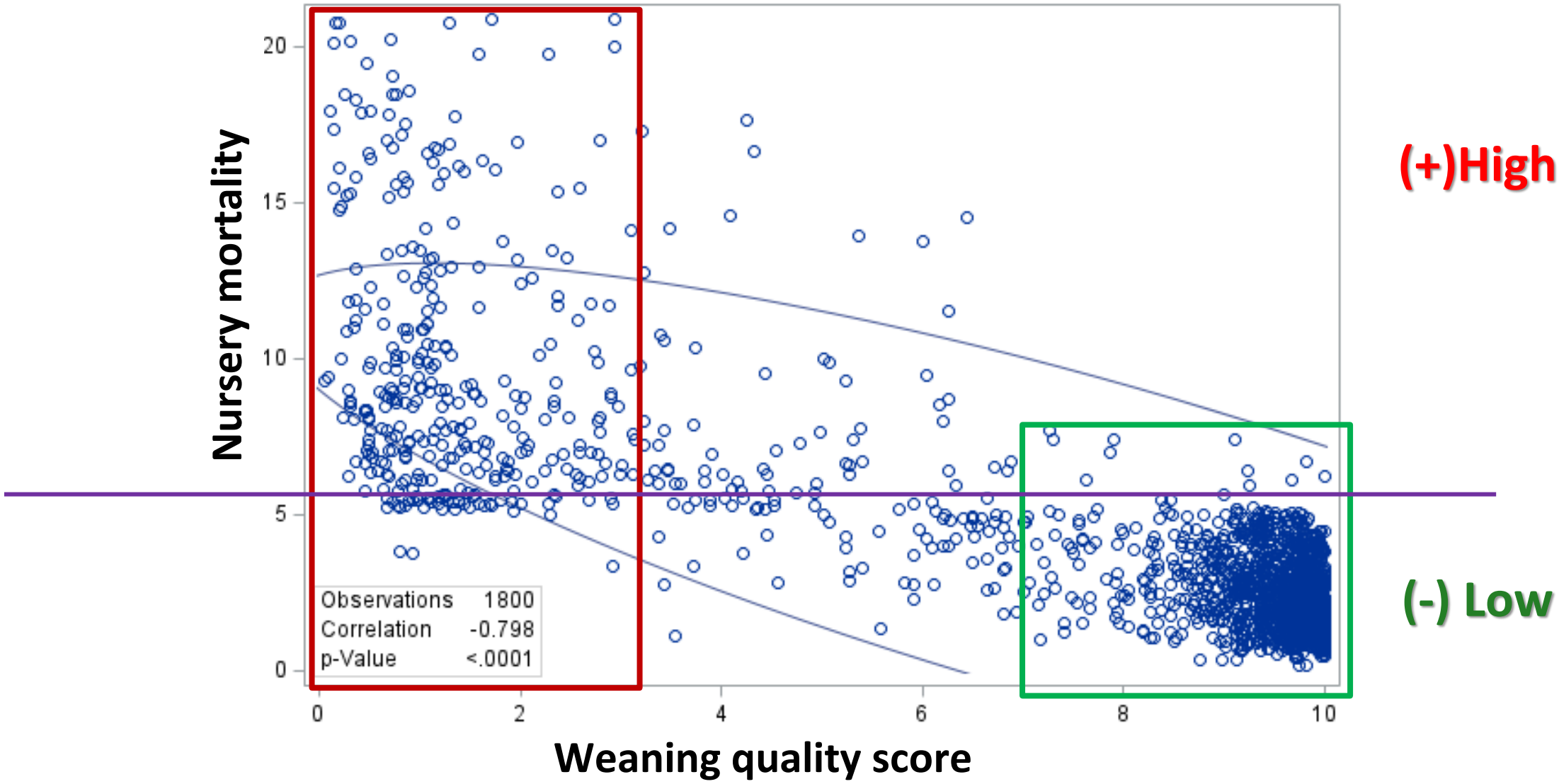
Sensitivity: 69.23%

Specificity: 90.43%

(+) Predicted value: 89.0%

(-) Predicted value: 72.7%

Using the weaning quality score to predict nursery mortality



Conclusion

- Fully automated system-specific data platform allows to:
  - Holistic swine system data analysis ➡ automated master table
  - *Identify and rank drivers of W2F performance*
  - *Forecast swine productivity*
  - *Weaning quality score ➡ predictor of performance*
  - *Measure the economic impact of diseases and/or interventions.*
  - *System specific ➡ need for update*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Questions?

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