The impact of wean-quality scores on a post-weaning performance: a data driven approach

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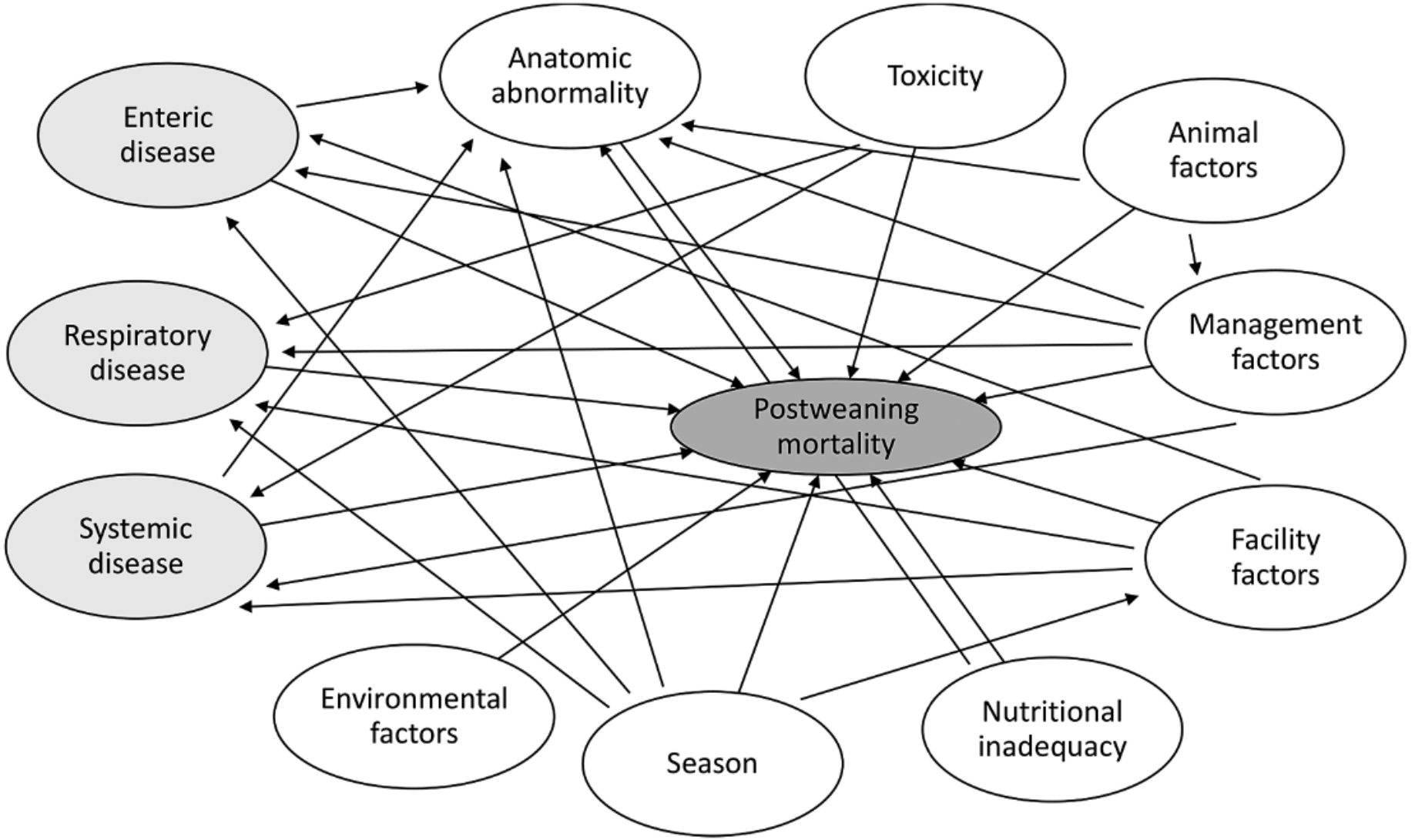
PROSPER
Predictors of Swine Performance

Gebhardt et al.



Article	Country	Year	Number of pigs	Weight, kg		Significant factors ($P \leq 0.05$)
				Start	End	
Losinger et al. (1998)	USA	1995–1996	N/A	N/A	N/A	Weaning age
						Source
Maes et al. (2001)	USA	1996–2000	1,345,127	N/A	N/A	Year
						Timing within finishing
Maes et al. (2004)	Belgium	1999–2002	828,385	25	113	Season
						Source
						Feeding duration
Larriestra et al. (2005a)	USA	1996–2000	1,720,040	23	N/A	Entry weight
						Days on feed
						Season
Oliveira et al. (2007)	Spain	1996–1997	120,751	18–20	N/A	Farm type
						Herd size
						Season
						Feeding duration
Oliveira et al. (2009)	Spain	1999–2002	158 batches	N/A	N/A	Quality of care
						Source
						Season
						Year
Agostini et al. (2013)	Spain	2008–2010	1,157,212	19	108	Season
						Number of pigs placed
						Number of sources
						Circovirus vaccine
						Antibiotic route
						Water source
Serrano et al. (2014)	Spain	2003–2005	42 farms	N/A	N/A	Presence of viral antibodies
						Farm type
Agostini et al. (2014)	Spain	2008–2009	454,855	20	104	Season
						Number of sources
						Ventilation type
						Initial bodyweight (IBW)
						IBW × ventilation type
						IBW × number of sources
Agostini et al. (2015)	Spain	2008–2010	1,040,116	19	106	Season
						Number of sources
						Ventilation type
						Number of pigs placed
Mehling et al. (2019)	USA	2015	115,213	7	115	Stocking density

Source
Sow Farm

Gebhardt et al.

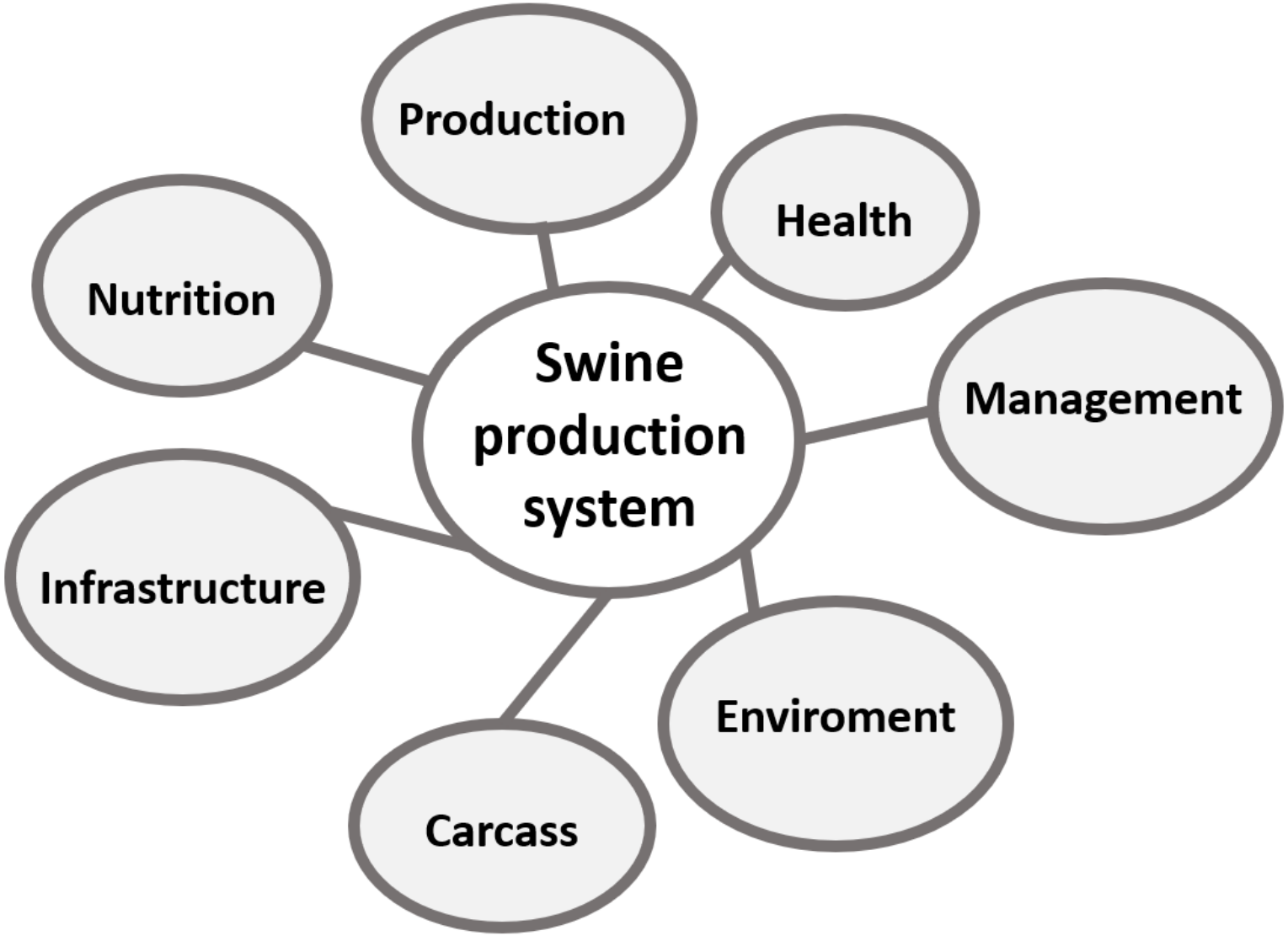
Quality Weaned Pig: A multifactorial approach

Key Points:

- **Health as a Foundation**: A healthy, stable sow herd is crucial for producing quality weaned pigs.
- **Management**: Proper farrowing house management and Day 1 pig care are essential for health.
- **Biosecurity**: Implement strict protocols to prevent disease spread and maintain herd stability.
- **Immunization**: Proper vaccination protocols for both sows and piglets, Good colostrum intake, and Optimal age and weight at weaning.

Adapted from PIC article: "Quality Weaned Pig: Focus on Health"

Data-driven approach: Whole herd or Holistic analysis



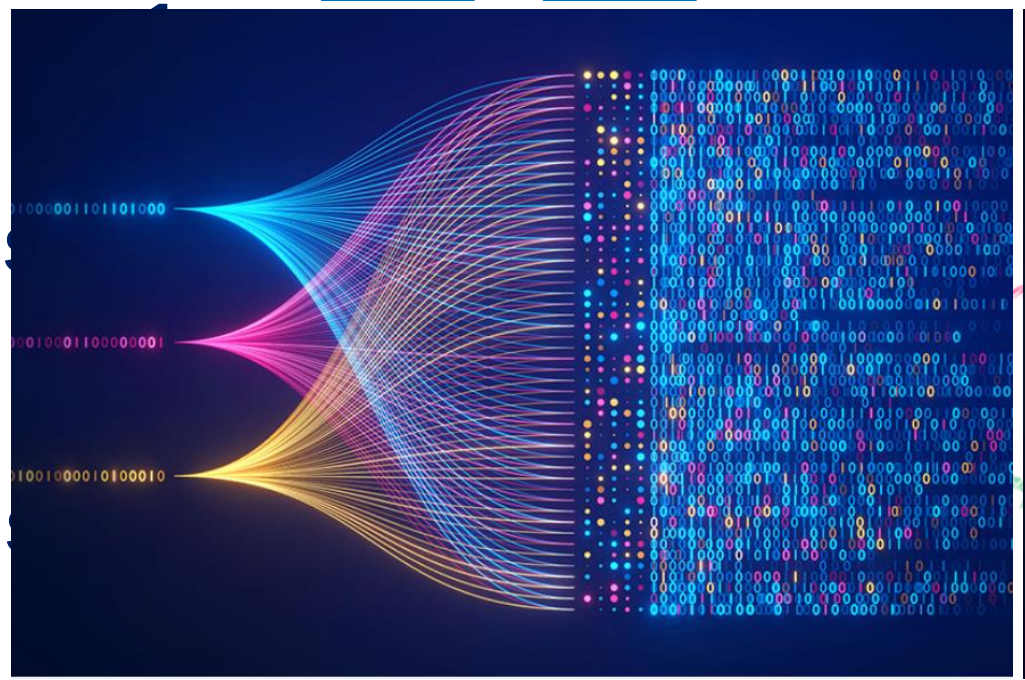
Building Master Tables (breeding-to-market)

Nursery

Finisher

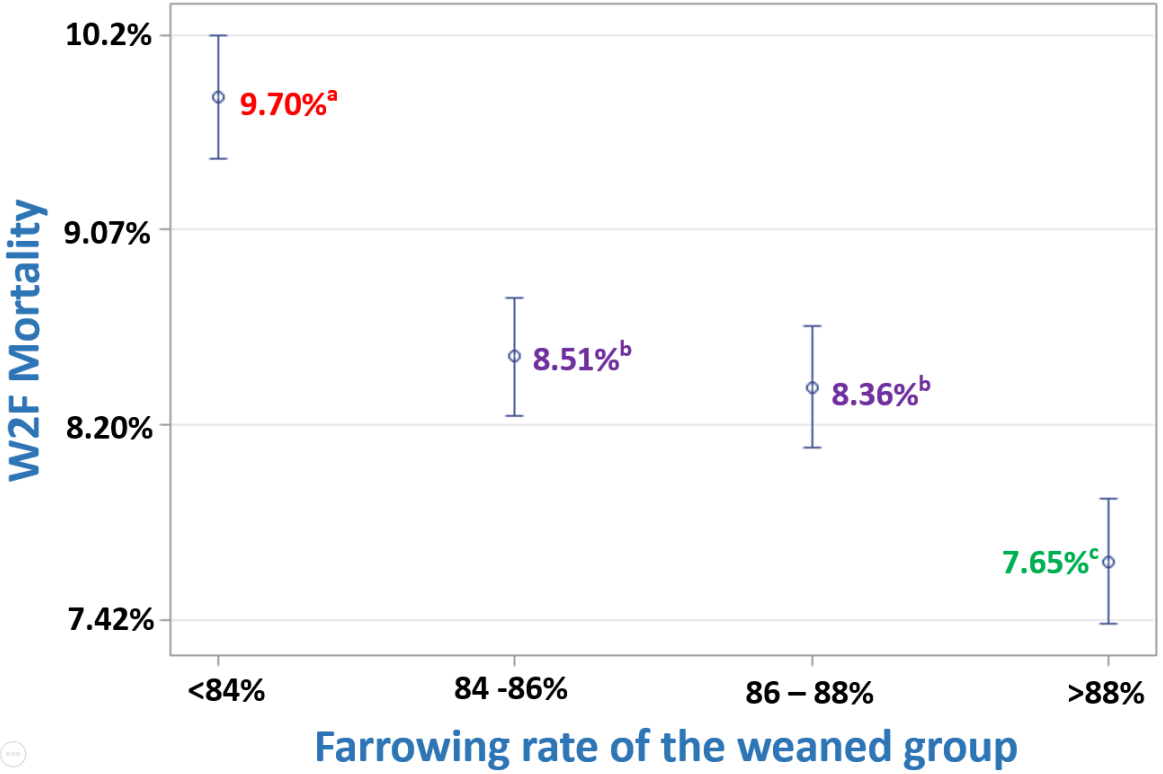
Week 1 Week 2

Sow farm

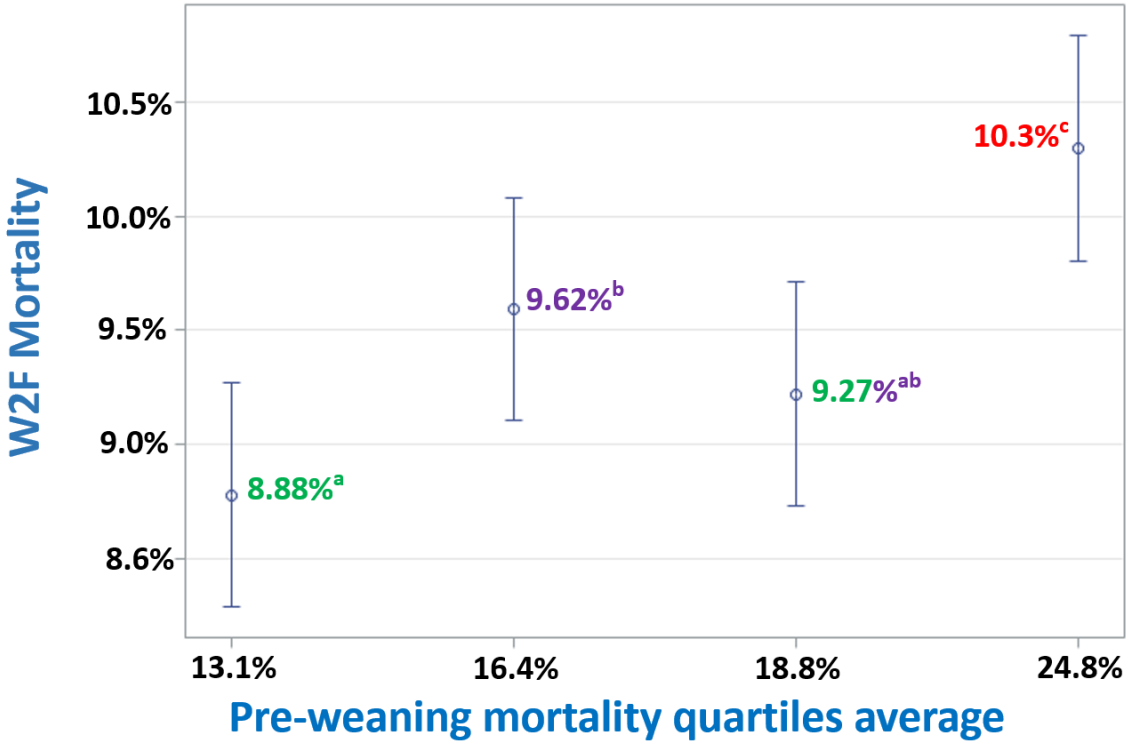


Sow farm importance on downstream mortality

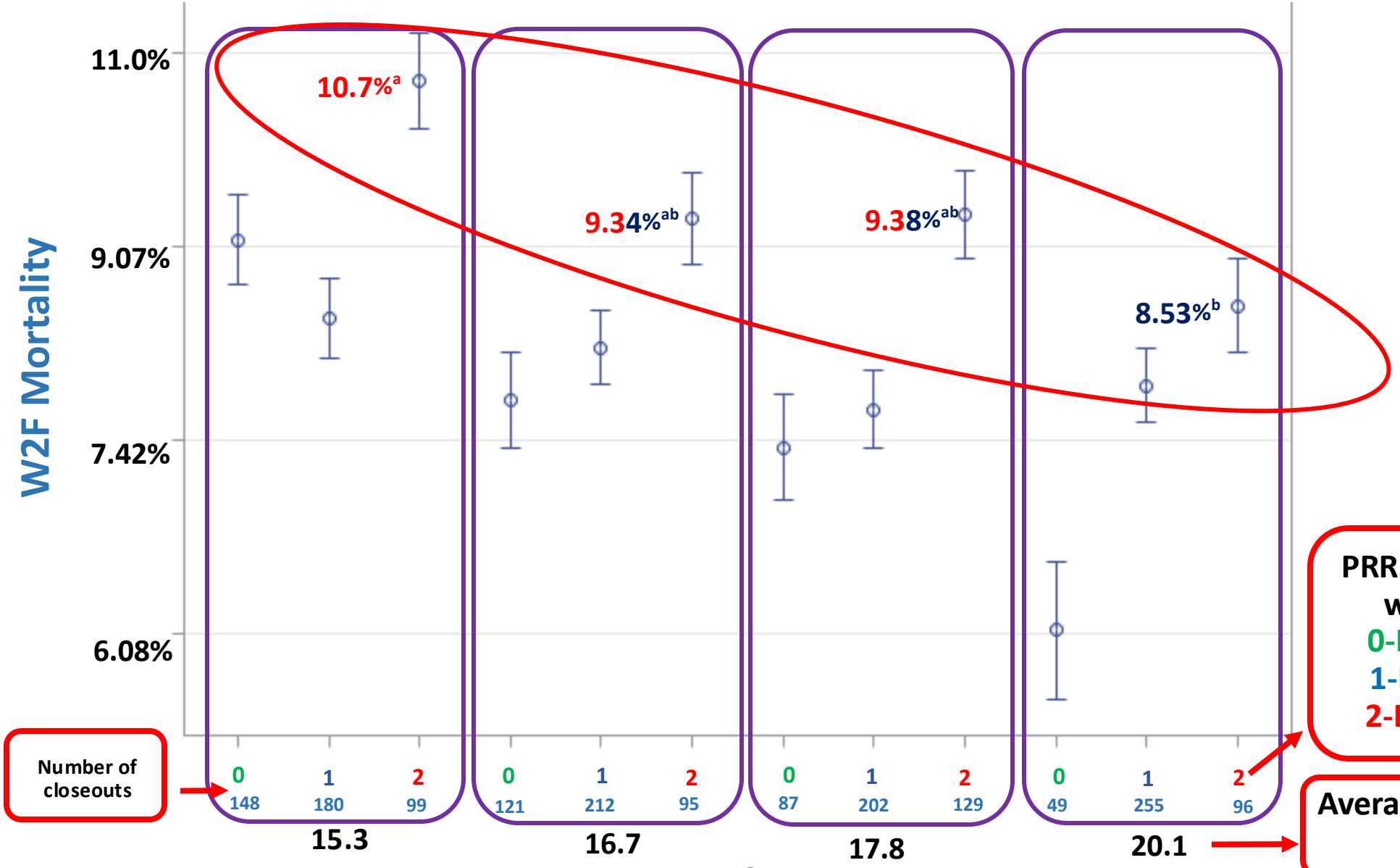
↑ Farrowing rate associated with ↓W2F mortality



↑ Pre-weaning mortality e associated with ↓W2F mortality

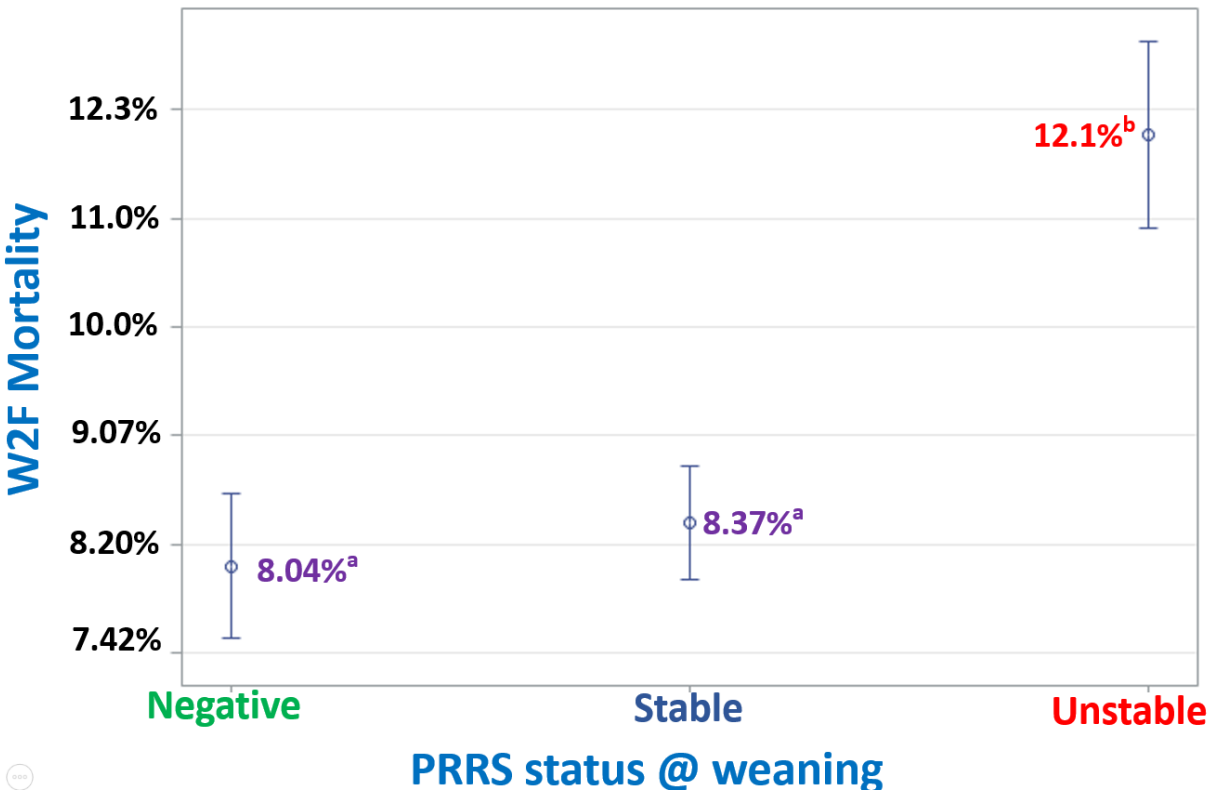


Acutely PRRSv-infected herds: ↑ W2F mortality all ages

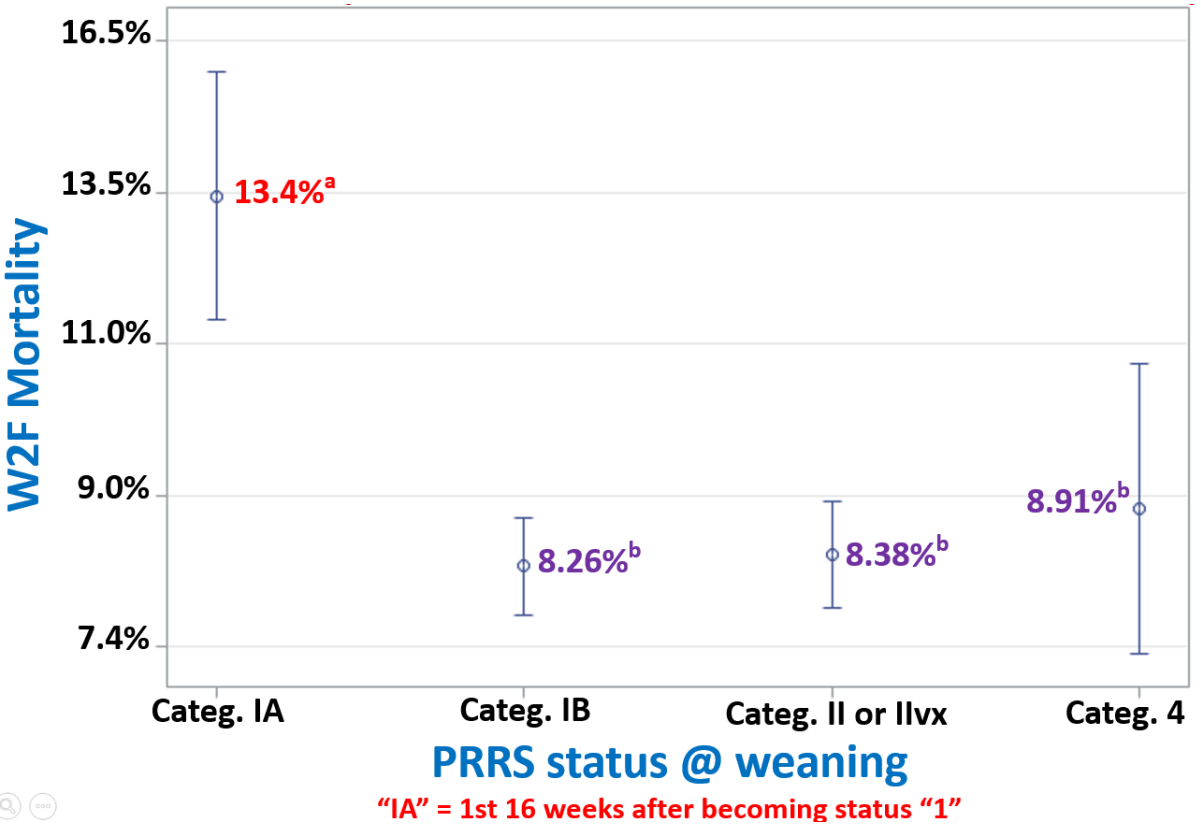


Sow farm health importance on downstream mortality

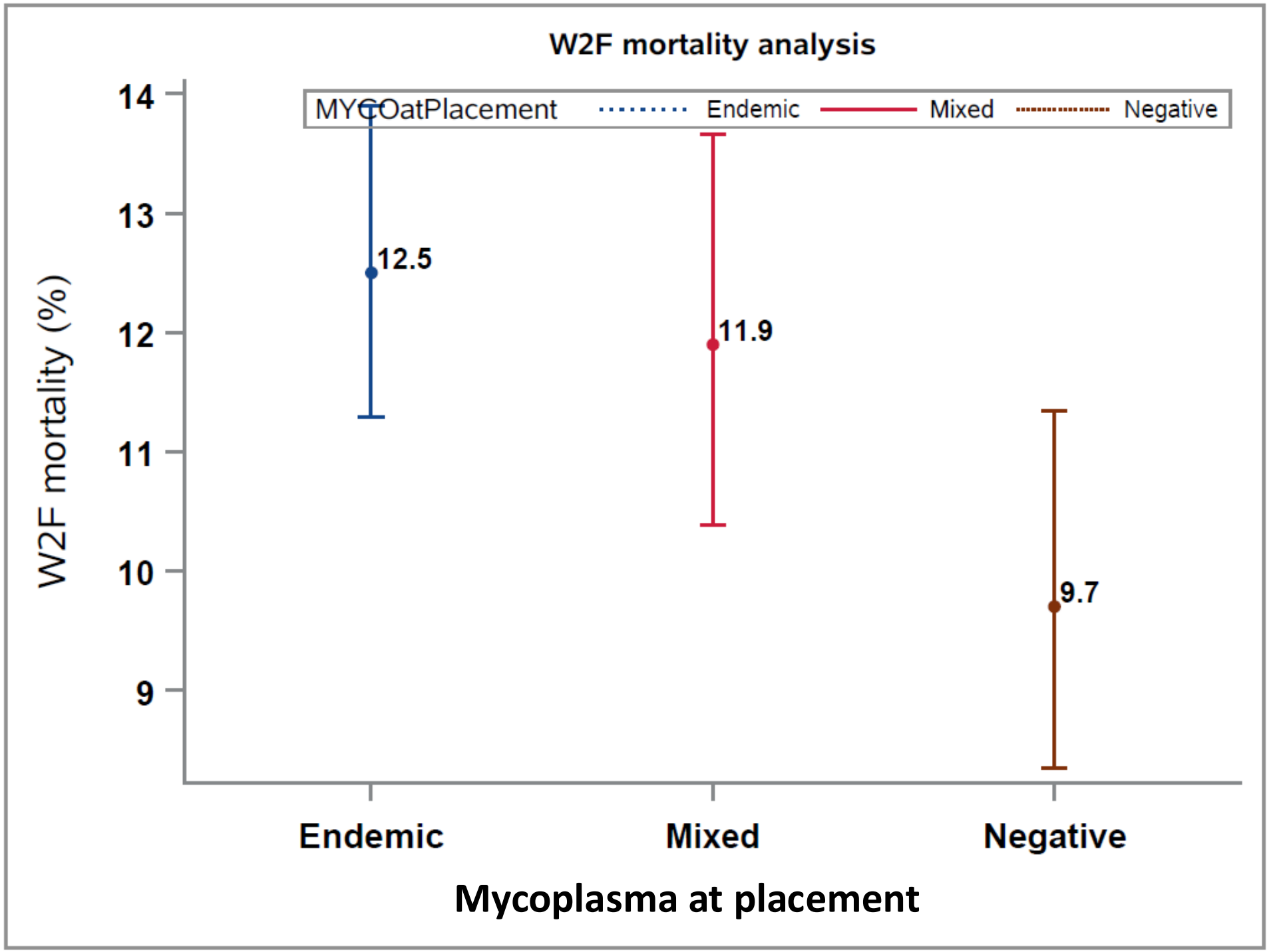
PRRS unstable groups ↑ W2F mortality



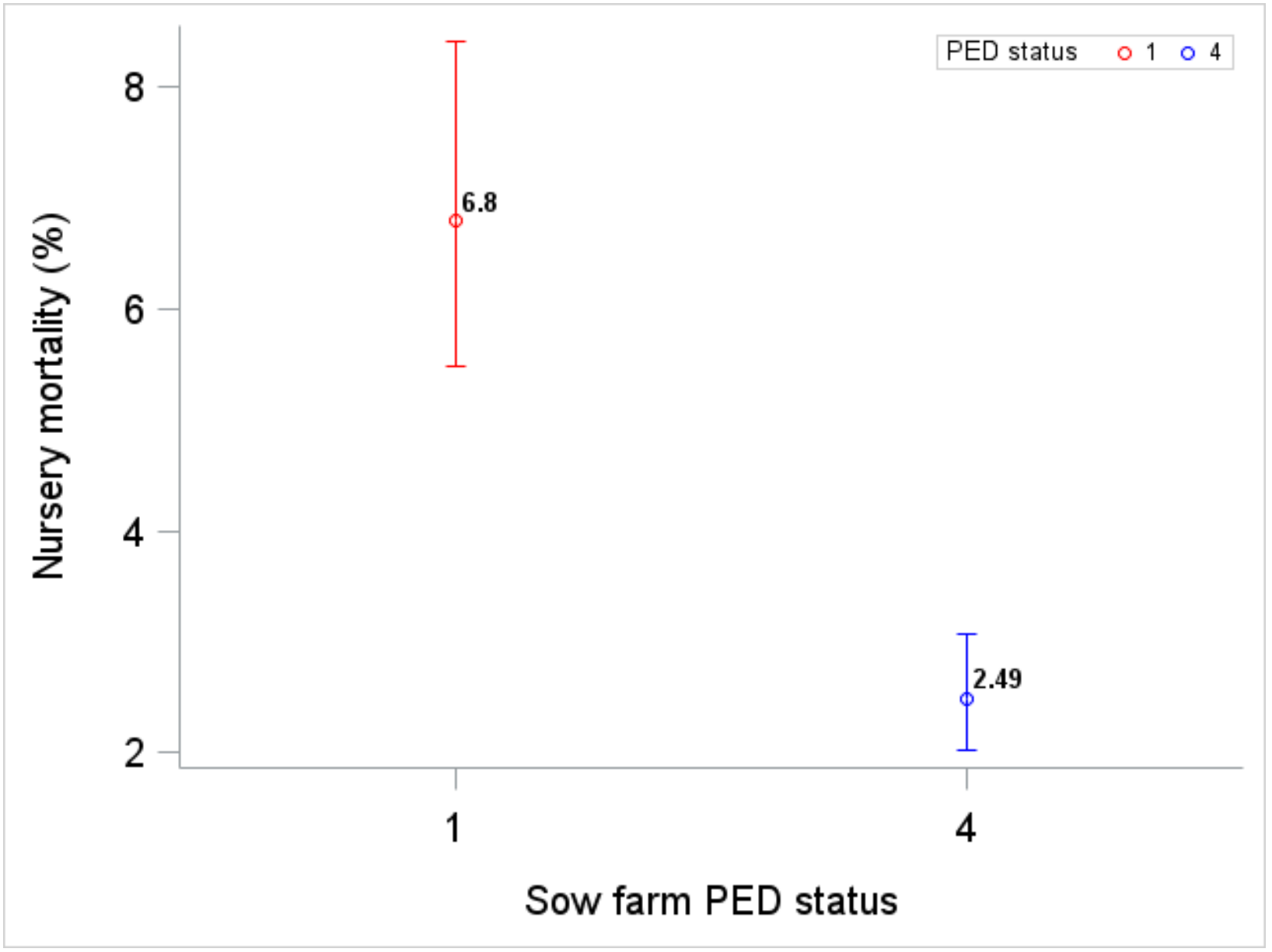
PRRS status equivalent to new "IA" - ↑ W2F mortality



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


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

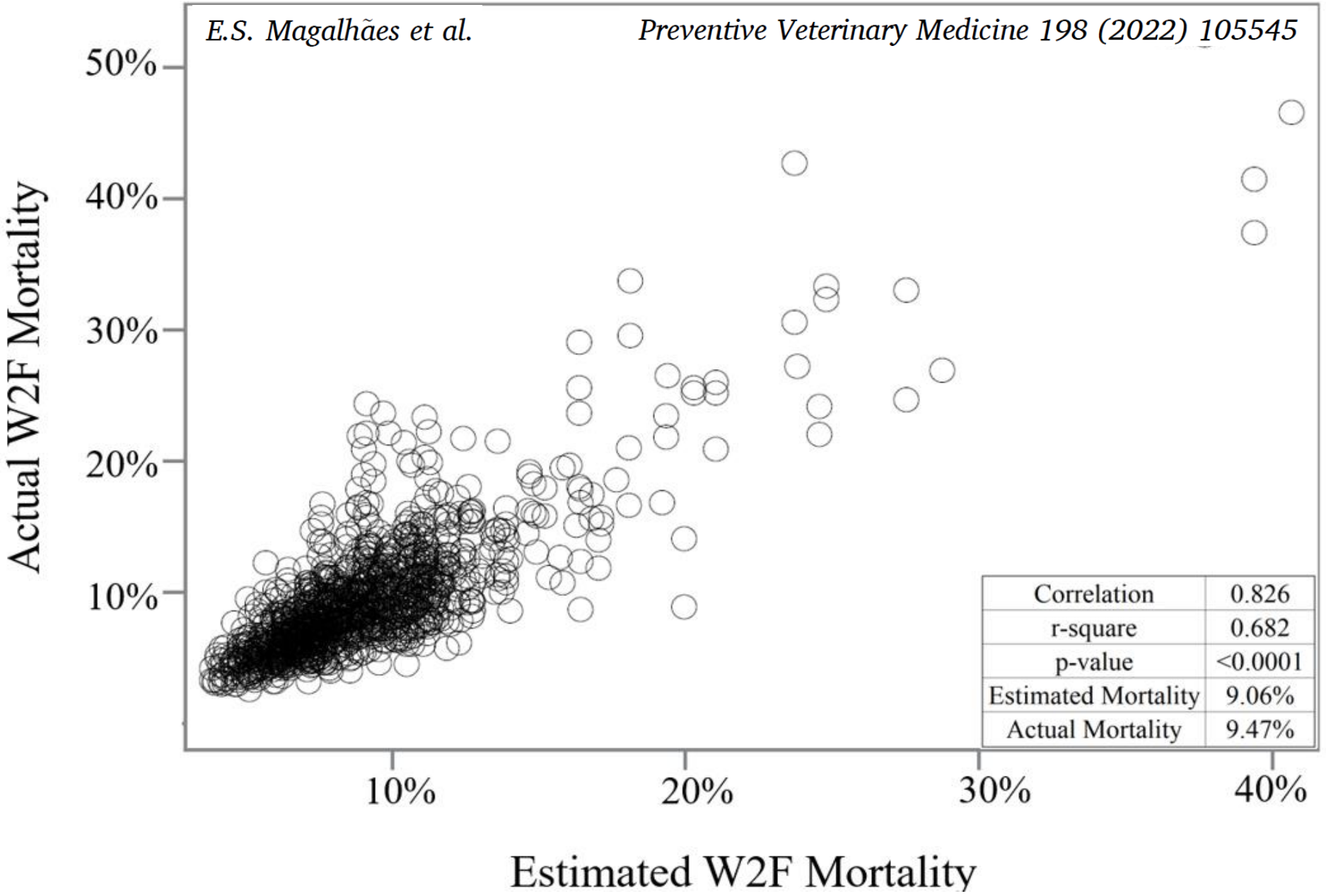
PED groups weaned after the outbreak had higher nursery mortality



PED status 1: Epidemic

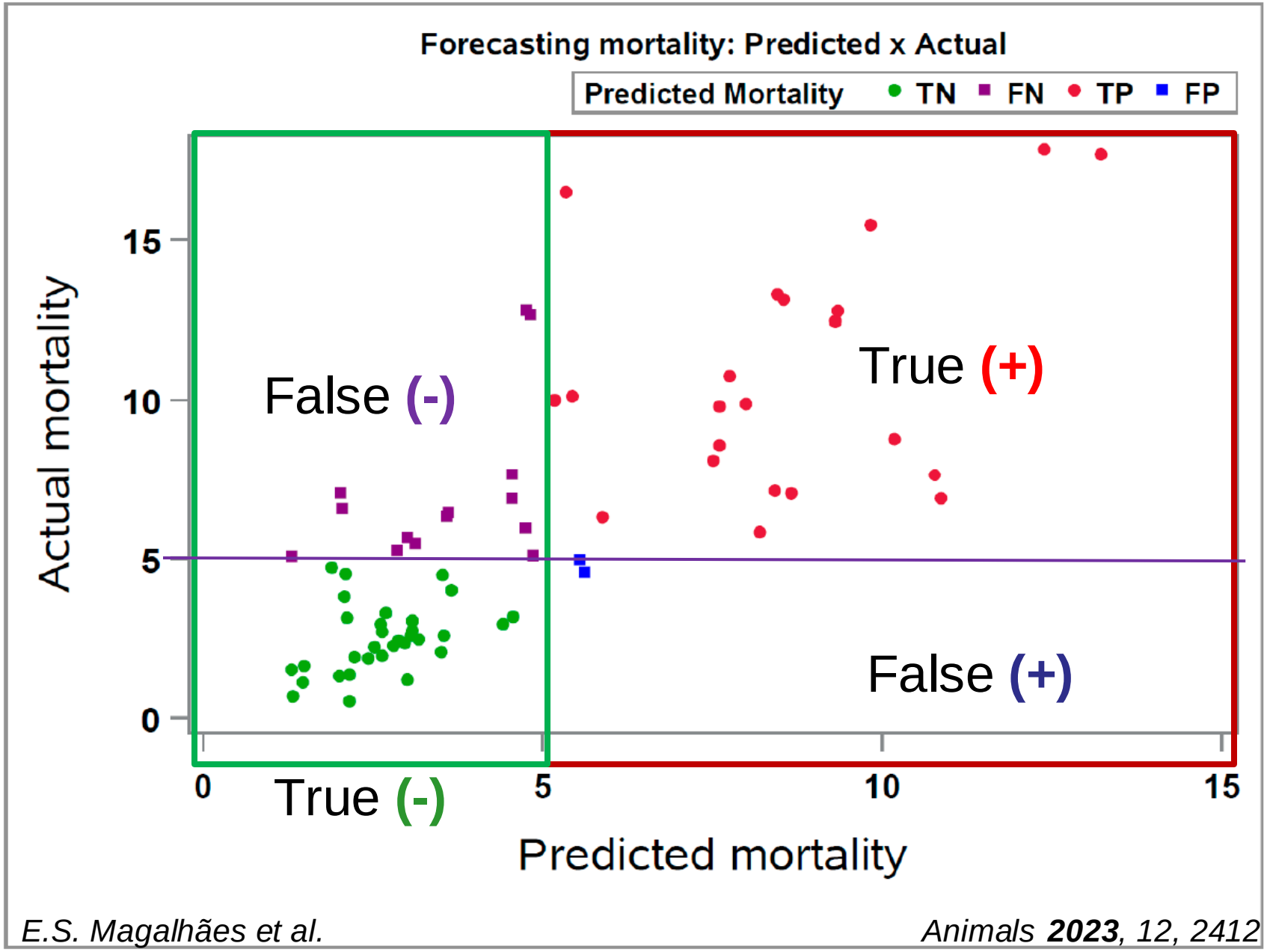
PED status 2: Naïve

Whole-herd risk factors of wean-to-finish mortality



W2F mortality

Final model had 0.826 of correlation with W2F mortality.



Forecasting performance

(R^2=0.554)

Accuracy: 77.78%

Sensitivity: 62.16%

Specificity: 94.29%

(+) Predicted value: 92.0%

(-) Predicted value: 70.2%

E.S. Magalhães et al. *Animals* ***2023***, *12, 2412*

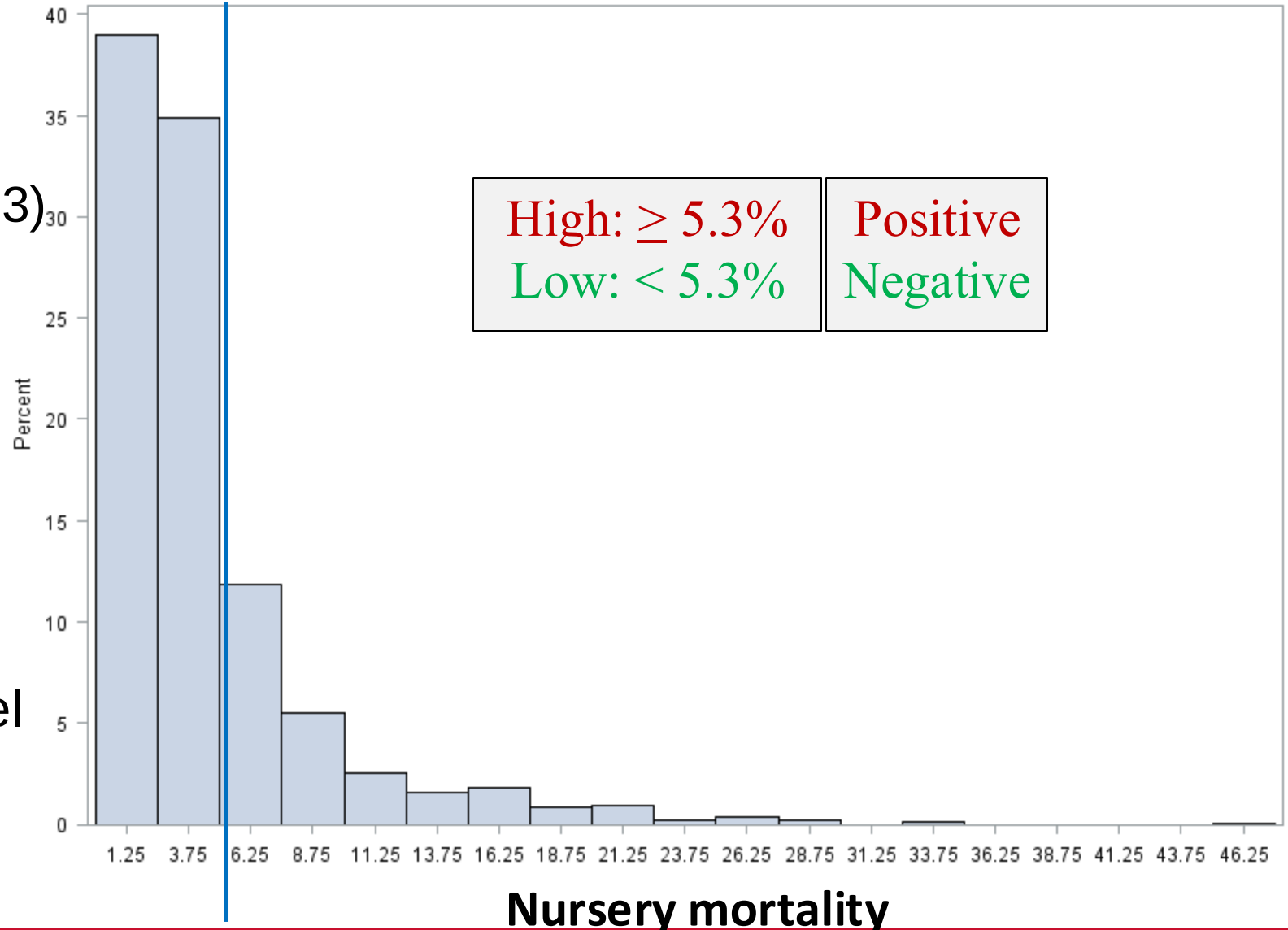
Creating a Wean-Quality-Score (WQS)

Overarching hypothesis: Implementation of machine-learning algorithms in swine data could improve the characterization of groups of pigs starting in the post-weaning phase.

Predicting nursery mortality using the wean-quality score

Forecasting nursery mortality:

- 1.723 closeouts (Jan 22 - Apr. 23)
- 1st - Train the model
  - 80% of the dataset
- 2nd – Test the model
  - 20% of the data
- Measure accuracy of the model



Creating a Wean-Quality-Score (WQS)

Table 2: Overall performance of the ML models on classifying the groups` 60-day mortality.

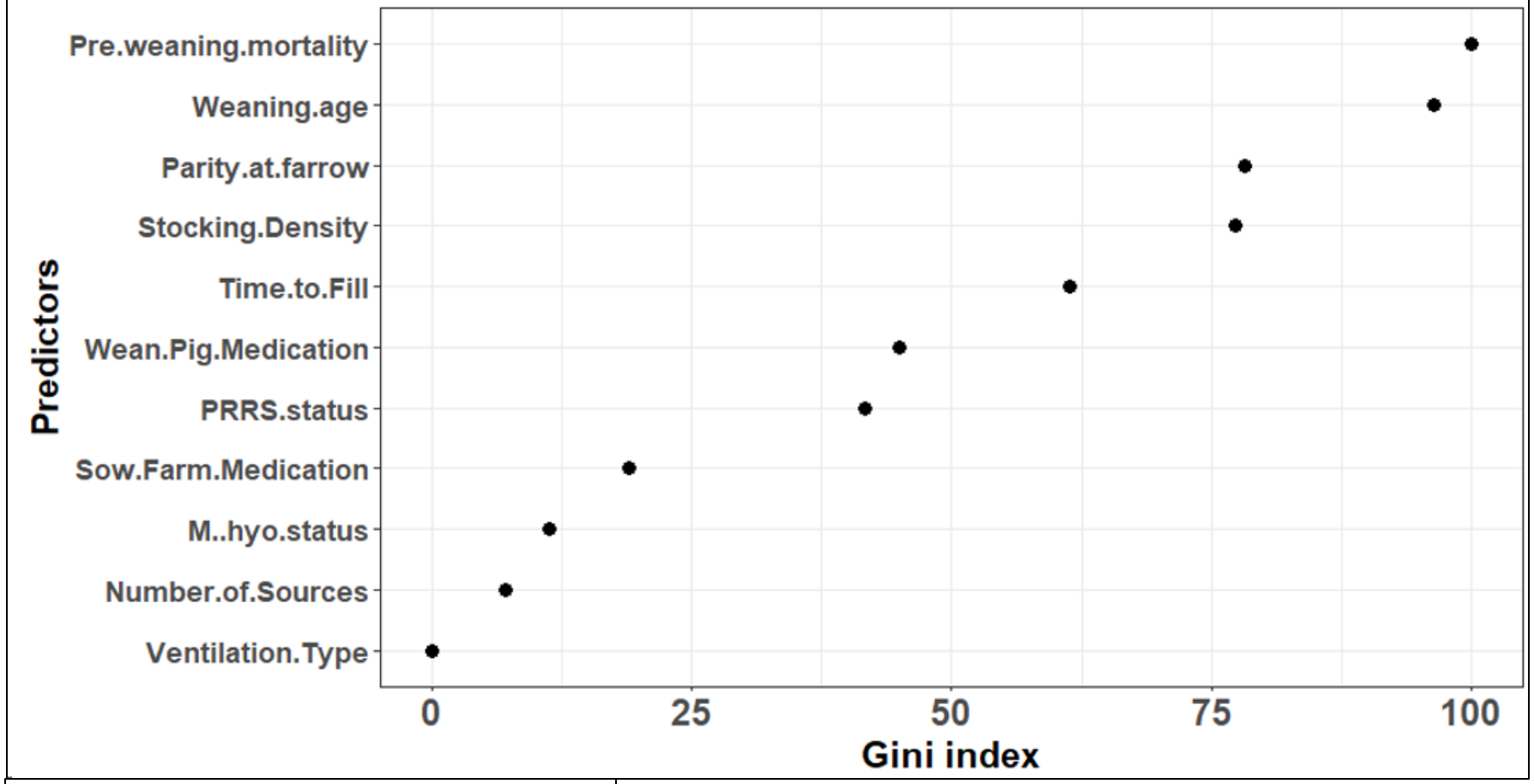
Performance Parameter*	Machine Learning Model		
	RF	*SVM*	*GBM*
ACC	0.9070	0.8140	0.8663
Se	0.8462	0.6964	0.7500
Sp	0.9248	0.8368	0.9015
PPV	0.7674	0.4535	0.6977
NPV	0.9535	0.9341	0.9225

* Performance on the ML models on the complete and unbalanced dataset after removing PRRS vaccine variable; ACC: accuracy; Se=Sensitivity; Sp=Specificity; PPV=Positive predictive value; NPV= Negative predictive value.

Magalhaes et al. (PVM)

Creating a Wean-Quality-Score (WQS)

Figure 1: Variable relative importance analysis using the RF model for the set of predictor variables.



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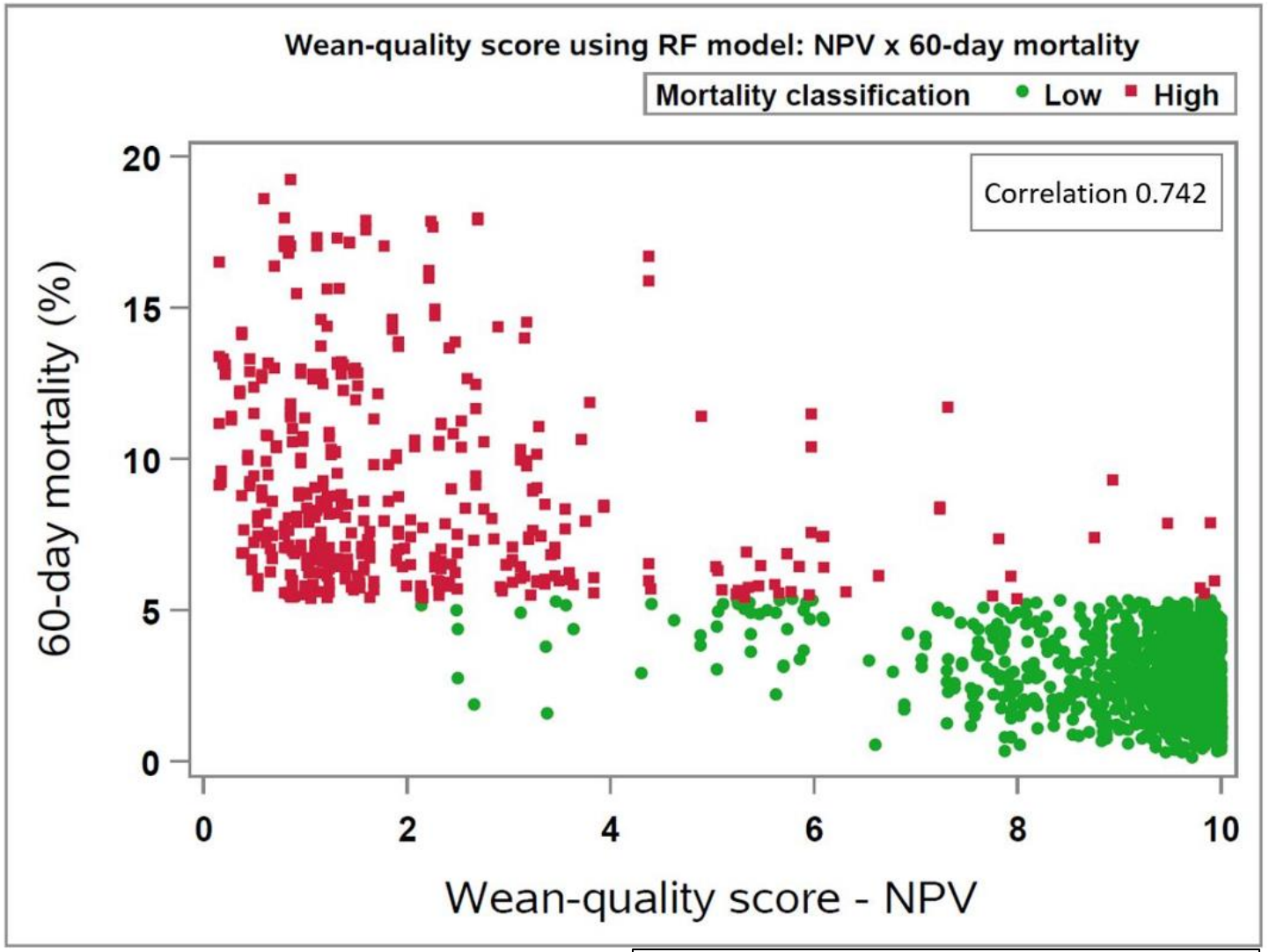
Creating a Wean-Quality-Score (WQS)

Pre-weaning mortality
Weaning age
Avg. parity
Stocking density
Time to fill
Wean pig medication
PRRS status
Sow medication
M. Hyo status
Number of sources
Ventilation type



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Discussion & take homes

- A Wean-Quality Score (WQS) was developed using ML.
- The WQS demonstrated a high accuracy for classifying high 60-day mortality groups.
- Random forest outperformed the other ML models.
- The most influential factors in predicting high 60-day mortality included:
  - Pre-weaning mortality
  - Average parity of litters
  - Stocking density
  - Weaning age
  - PRRS status
  - Time to fill the barn.

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Solutions for swine health & productivity

Thank you!

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