Role of the Microbiome in Disease Outcome of Swine

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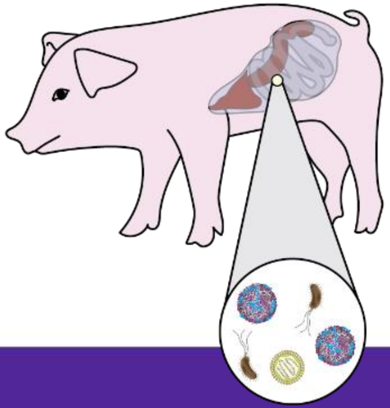
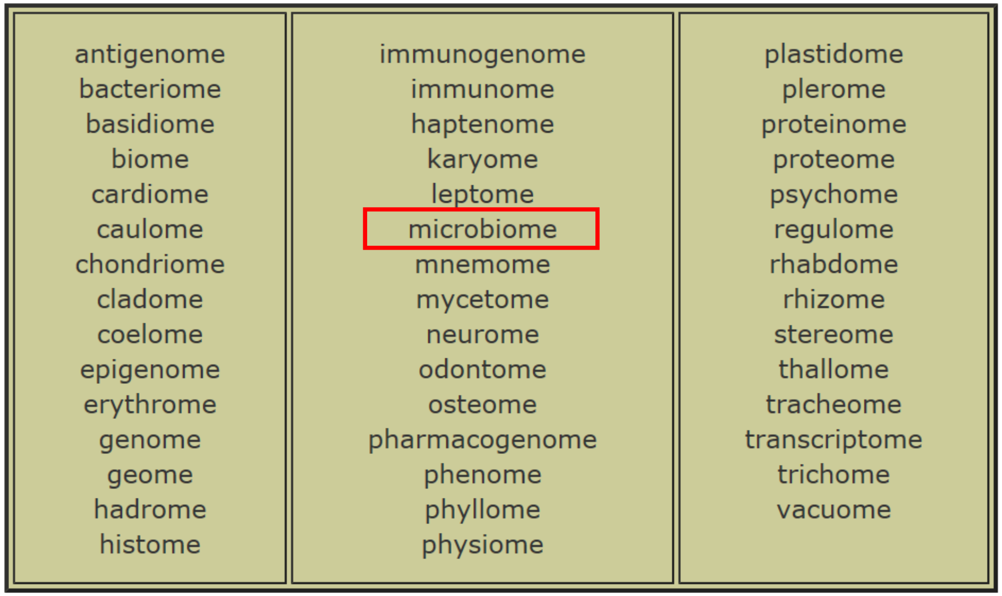


Microbiome

"…the ecological community of commensal, symbiotic, and pathogenic microorganisms that literally share our body space"



antigenome
bacteriome
basidiome
biome
cardiome
caulome
chondriome
cladome
coelome
epigenome
erythrome
genome
geome
hadrome
histome
immunogenome
immunome
haptenome
karyome
leptome
microbiome
mnemome
mycetome
neurome
odontome
osteome
pharmacogenome
phenome
phyllome
physiome
plastidome
plerome
proteinome
proteome
psychome
regulome
rhabdome
rhizome
stereome
thallome
tracheome
transcriptome
trichome
vacuome

Lederberg, J. and A. T. McCray. 2001. 'Ome Sweet 'Omics - a genealogical treasury of words. *Scientist*, 15.

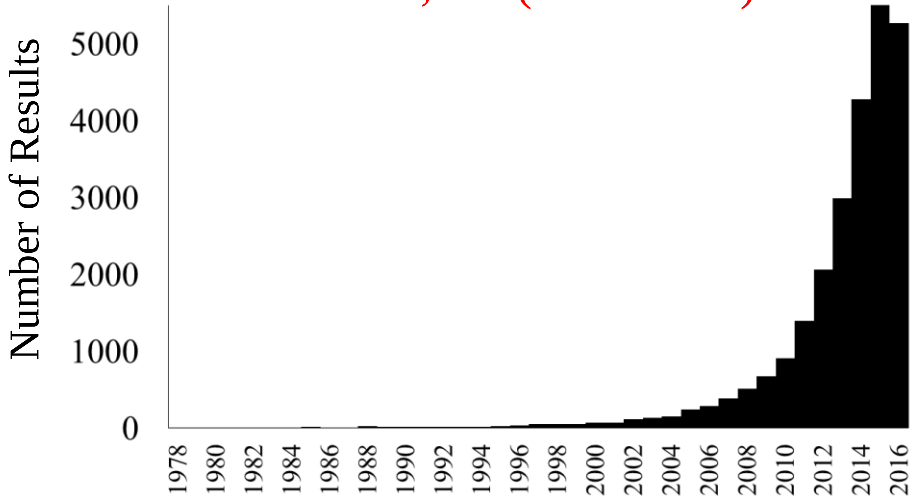
Emerging Area of Study

NIH Human Microbiome Project

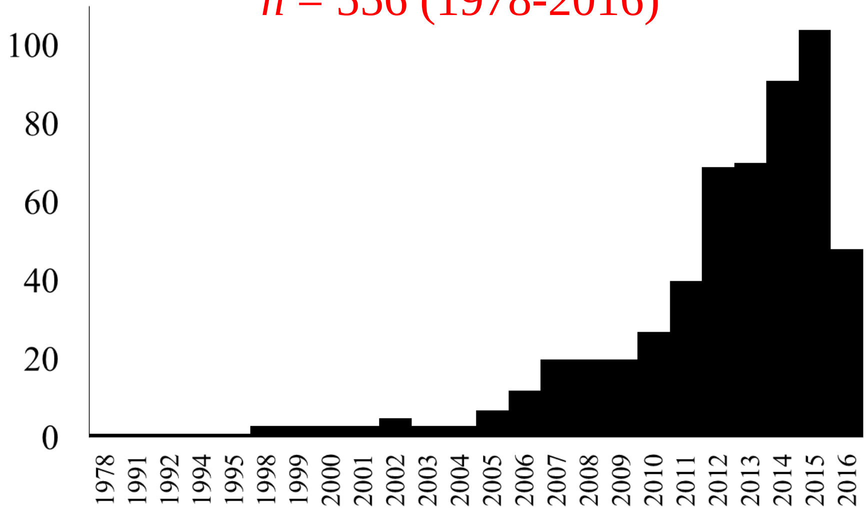
Understanding the microbiome in human health and disease

(Peterson et al., 2009)

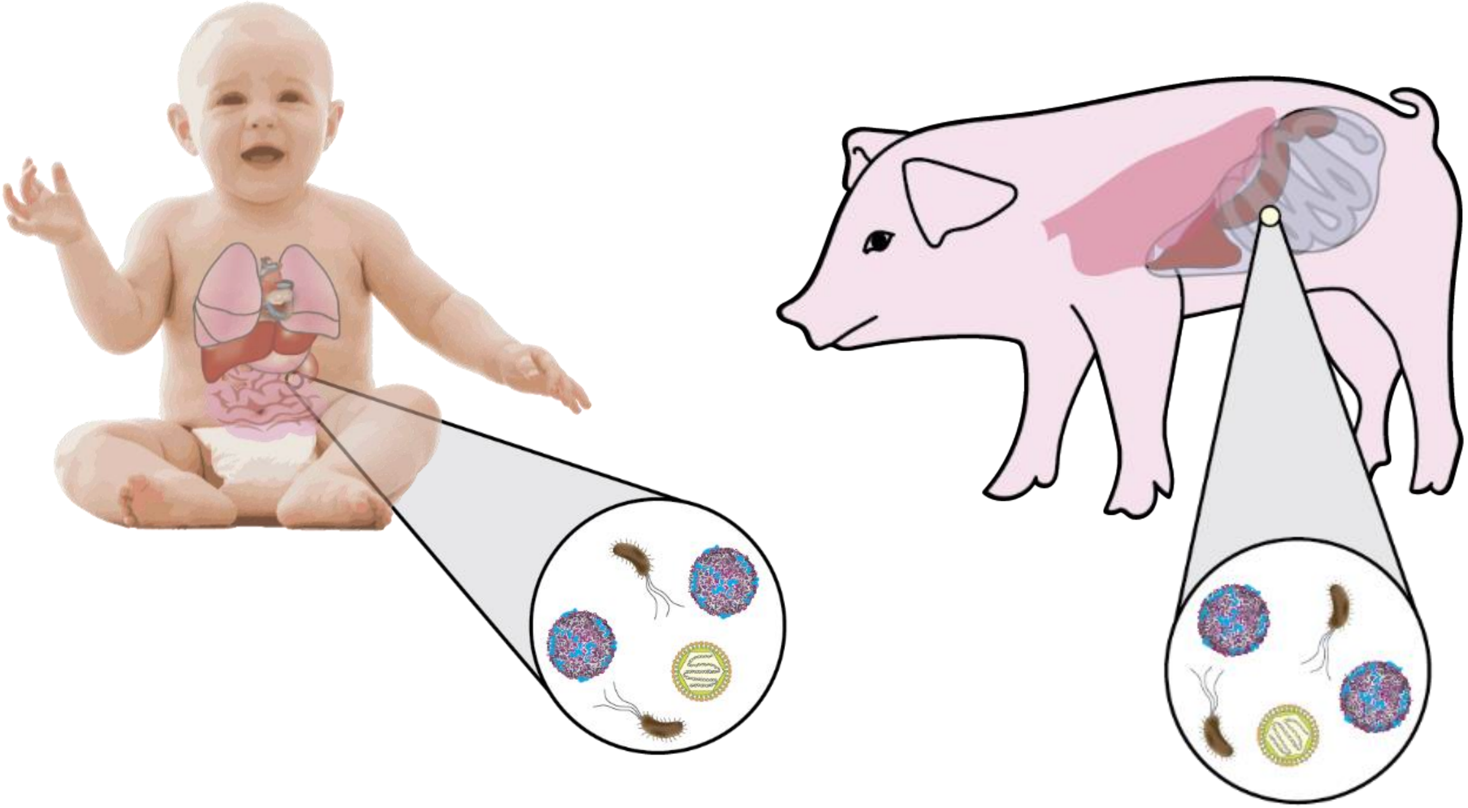
“Human Microbiome”
n = 25,671 (1978-2016)



“Swine Microbiome”
n = 556 (1978-2016)



Microbial colonization



The vast majority of microorganisms live in the
GASTROINTESTINAL TRACT (10 microbes: 1 human cell)

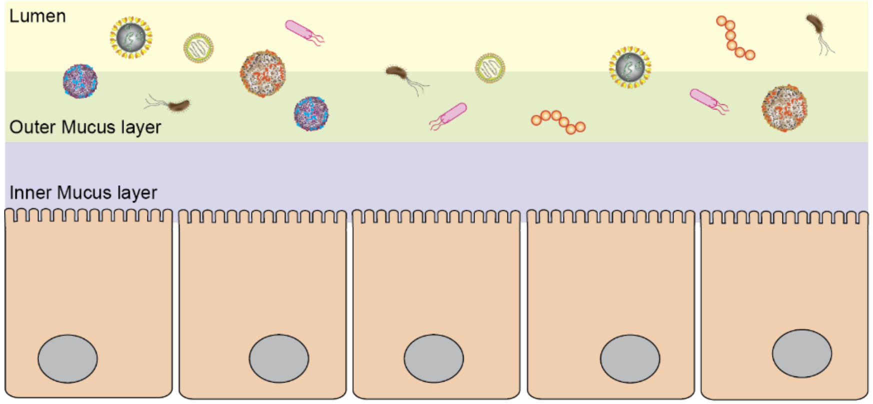
Includes bacteria, viruses, fungi, protozoa, archeae

Roles of the Microbiome

Absorption, metabolism and storage of calories

Development and Regulation of Immunity

Protective Barrier Function



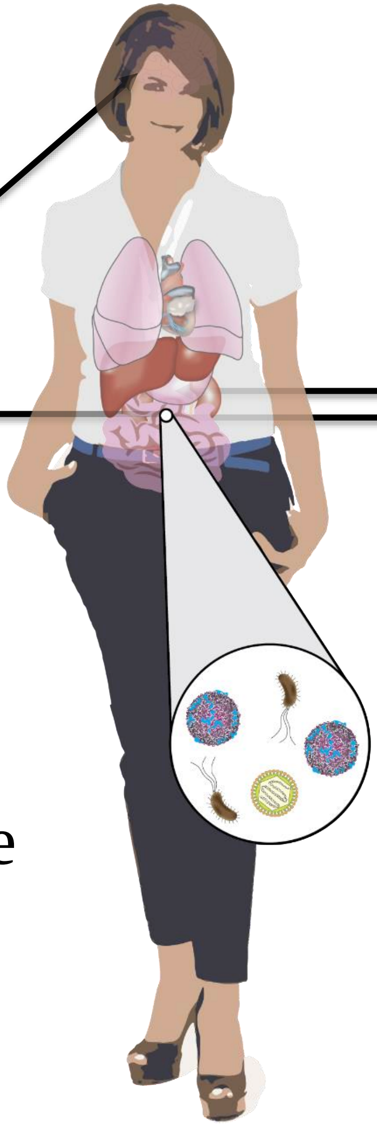
Microbiome in Health and Disease

The role is complex and not well understood

Microbiome diversity and composition play a role in

1. Disease susceptibility
2. Response to pathogens

Microbiome and Disease



Gut-brain axis

Gut-gut interactions

Autism

Increased *Clostridium* species

(Kraneveld et al., 2016)

Chronic fatigue syndrome

Decreased microbiome diversity

(Giloteaux et al., 2016)

Clostridium difficile

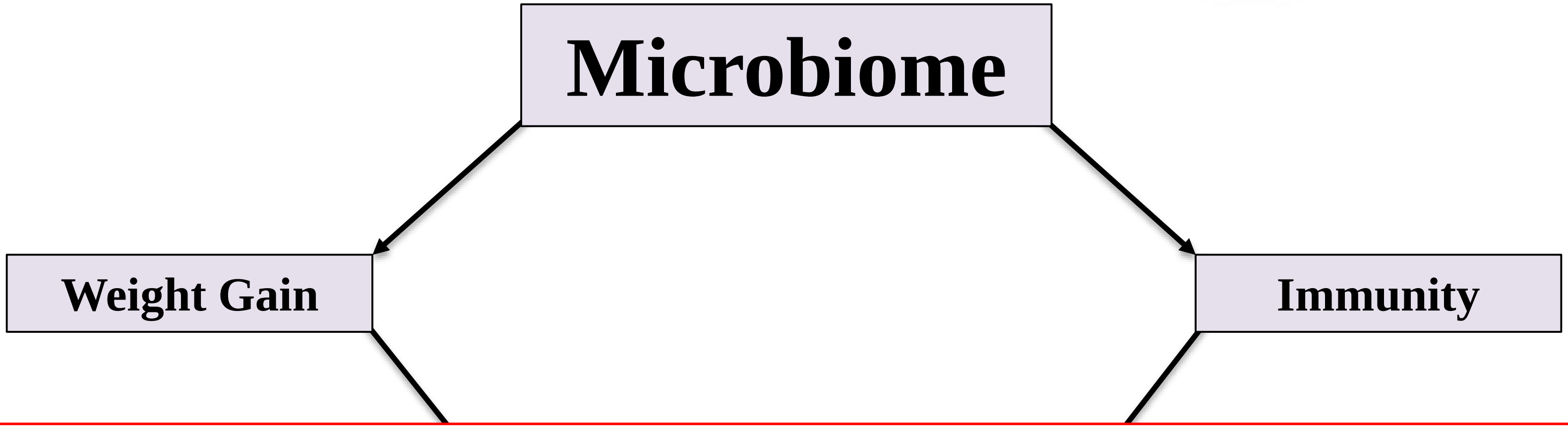
Decreased microbiome diversity

(Ross et al., 2016)

Obesity

Increased Firmicutes bacteria

(Kallus and Brandt, 2012)

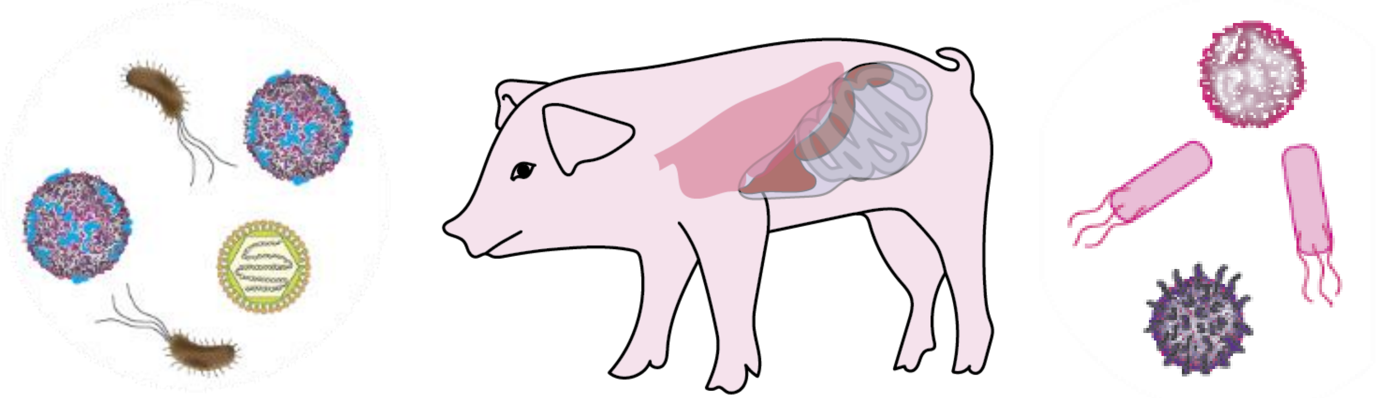


Microbiome

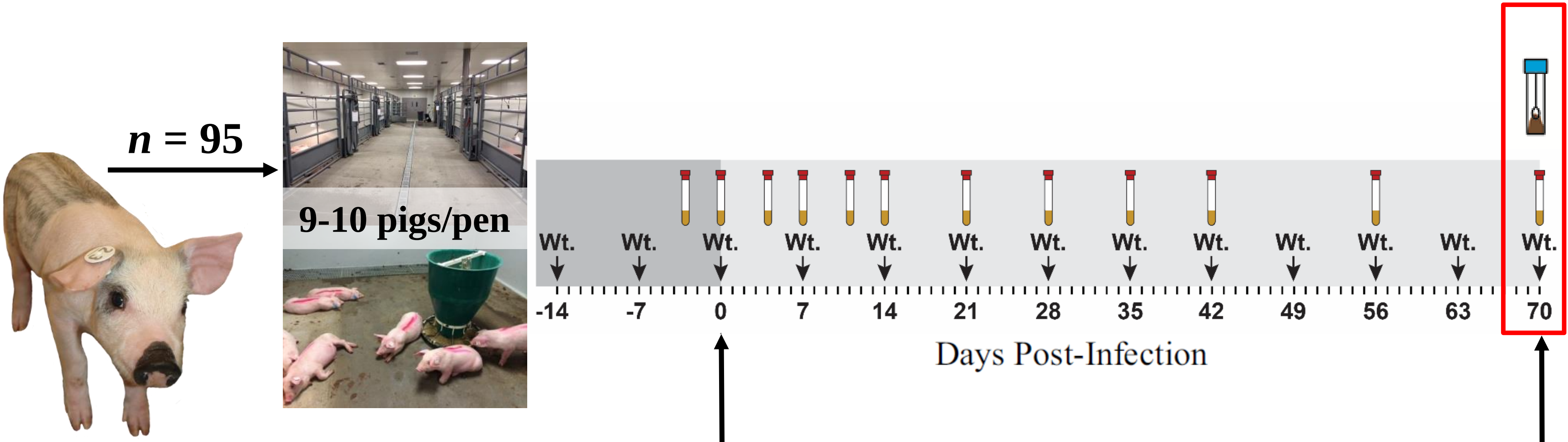
Weight Gain

Immunity

Are there microbiome characteristics associated with outcome during PRRSV/PCV2 co-infection?



Experimental Design



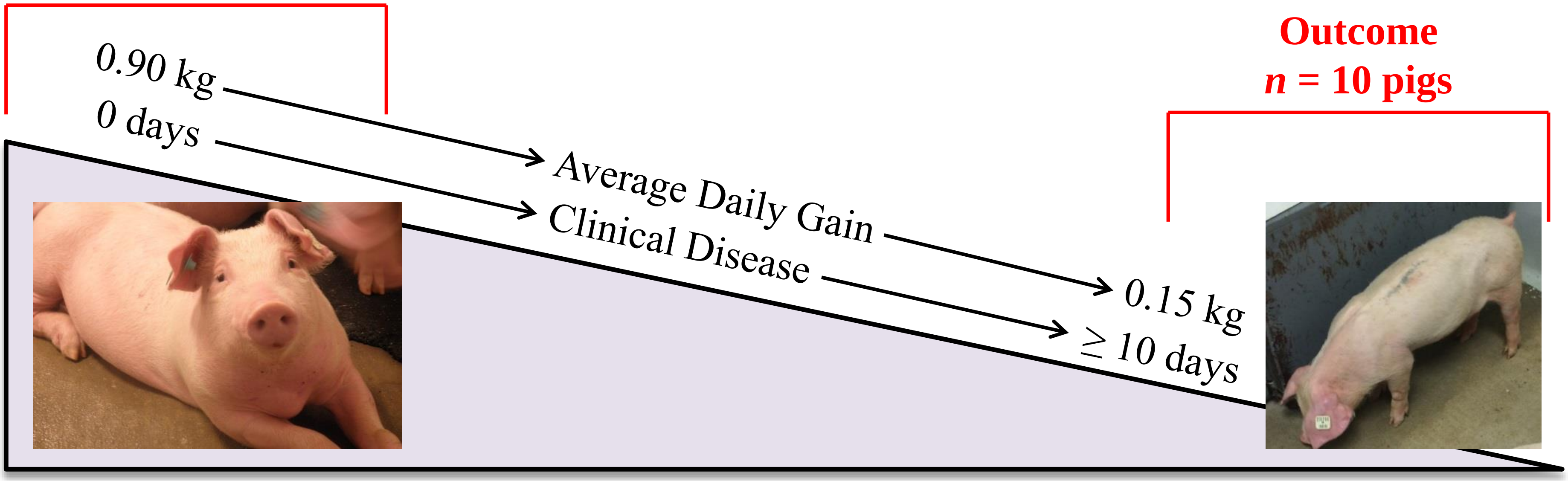
n = 95

9-10 pigs/pen

PRRSV/PCV2 Challenge

20 Pigs Selected for Best or Worst Clinical Outcome

Selection of Pigs



Best Clinical Outcome
***n* = 10 pigs**

0.90 kg → Average Daily Gain → 0.15 kg

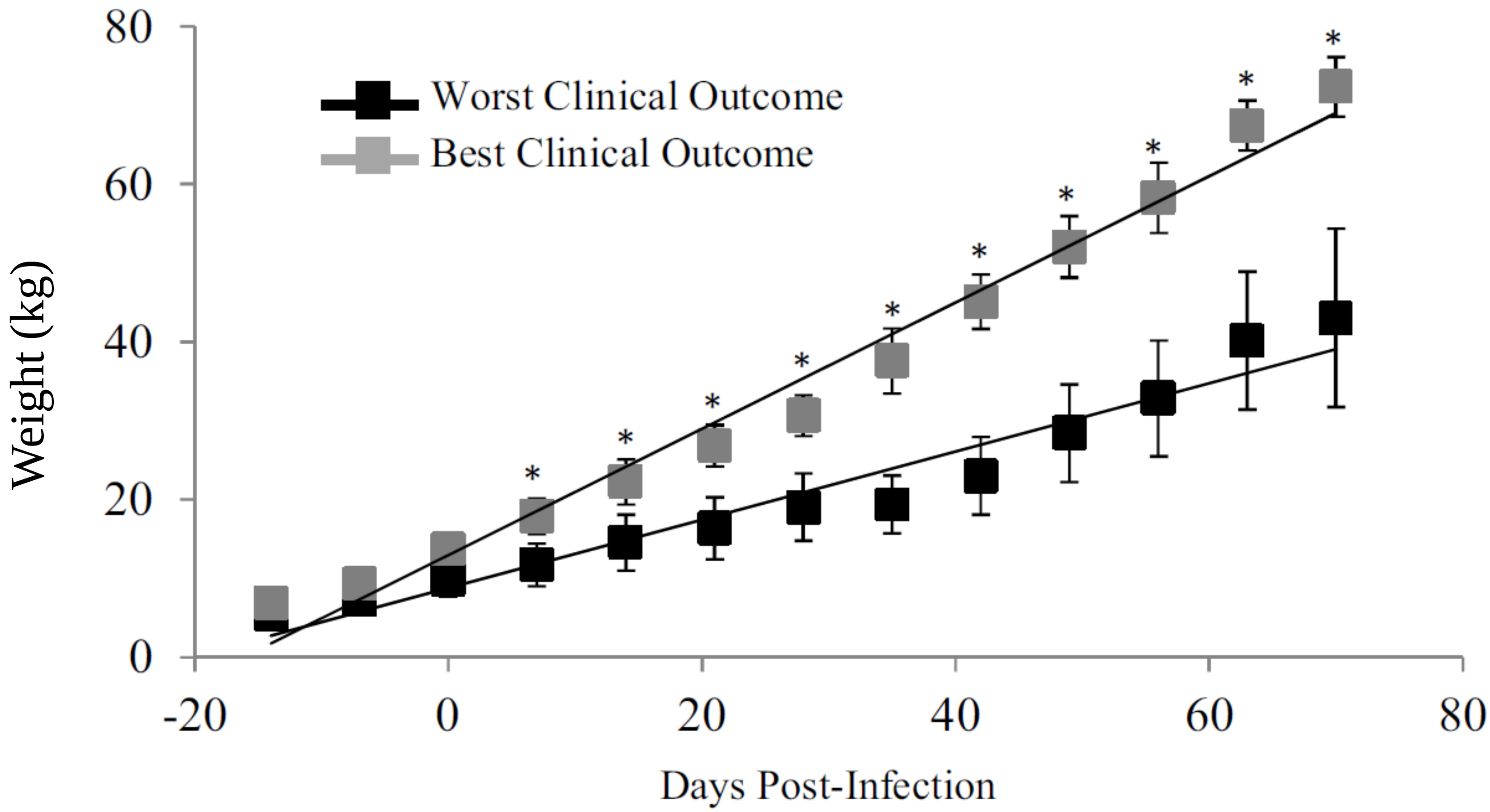
0 days → Clinical Disease → ≥ 10 days

Worst Clinical Outcome
***n* = 10 pigs**

Weight Gain

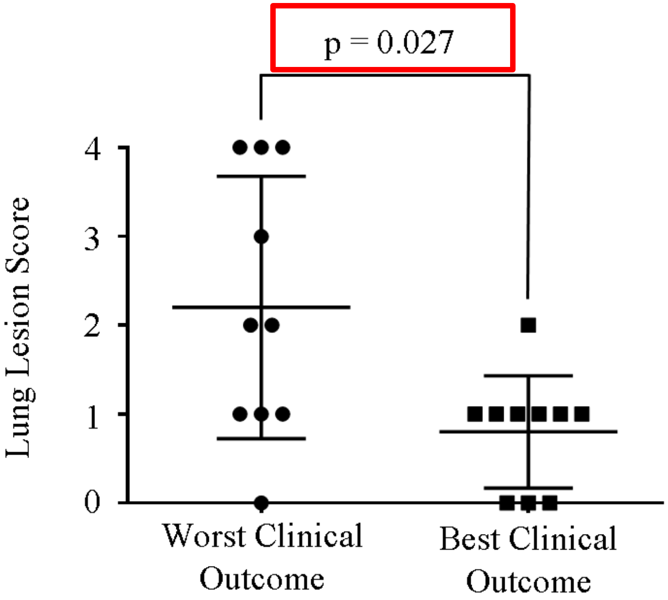
Worst Performing Group: 0.475 ± 0.153 kg
Best Performing Group: 0.837 ± 0.042 kg

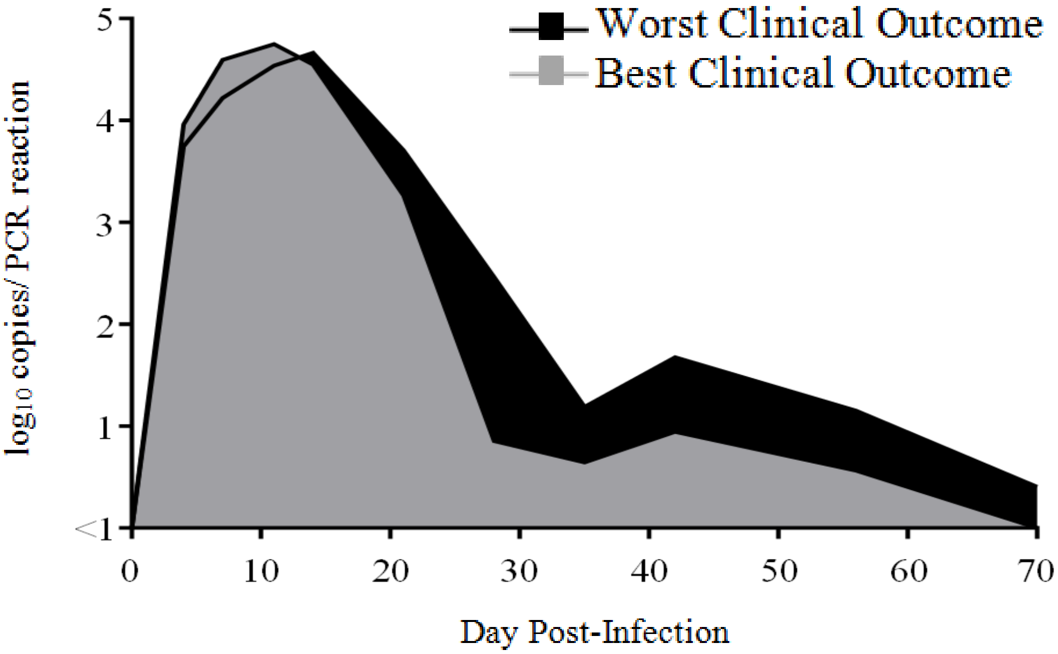
$p < 0.0001$

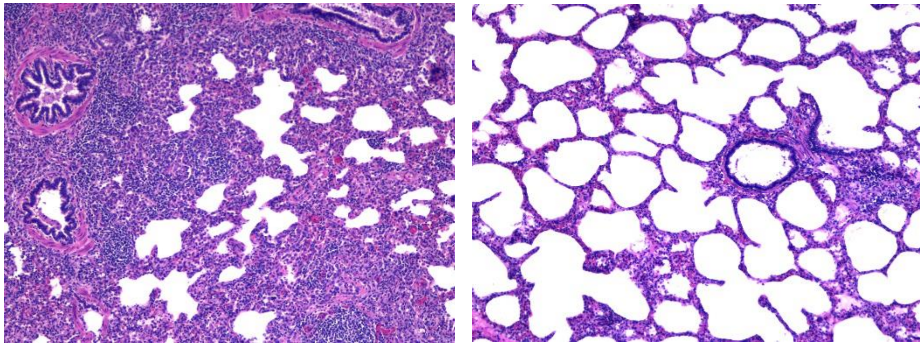


Niederwerder et al., 2016

Lung Lesions and PRRSV Viremia







Area Under the Curve (p = 0.04)
Worst = 153.5 Best = 116.2

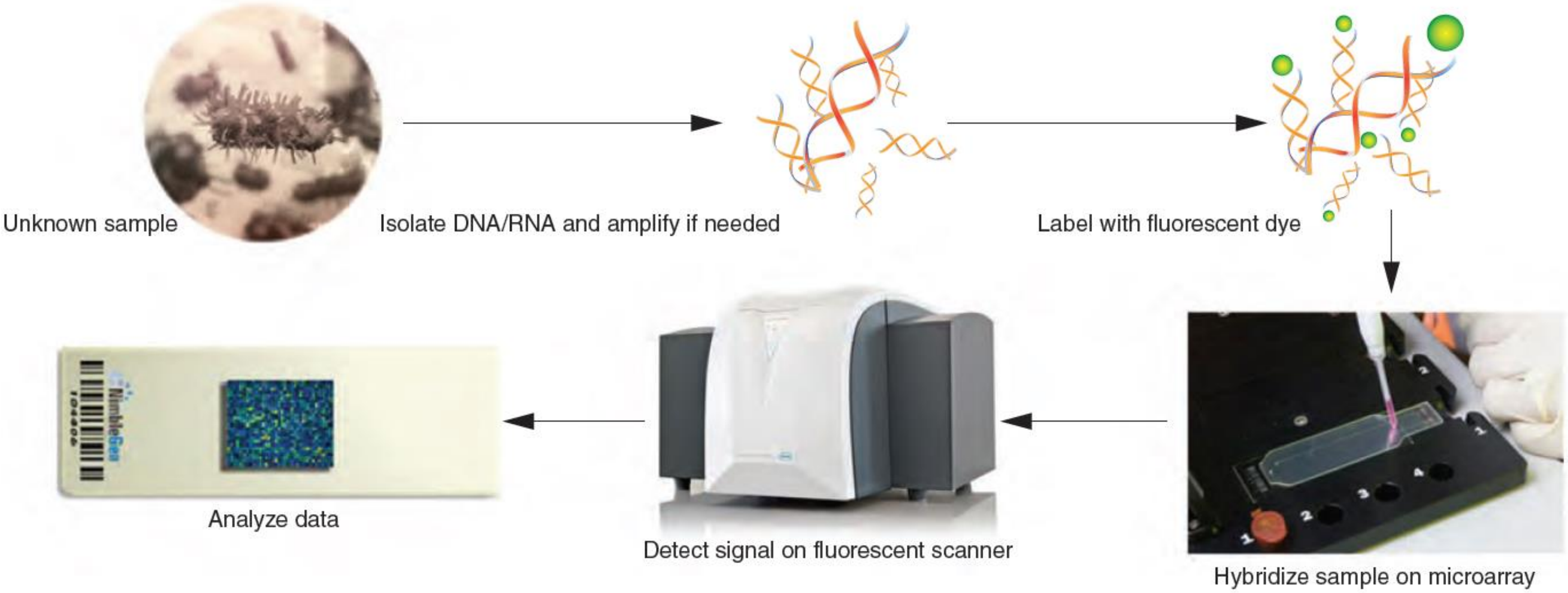
Niederwerder et al., 2016

Microbiome

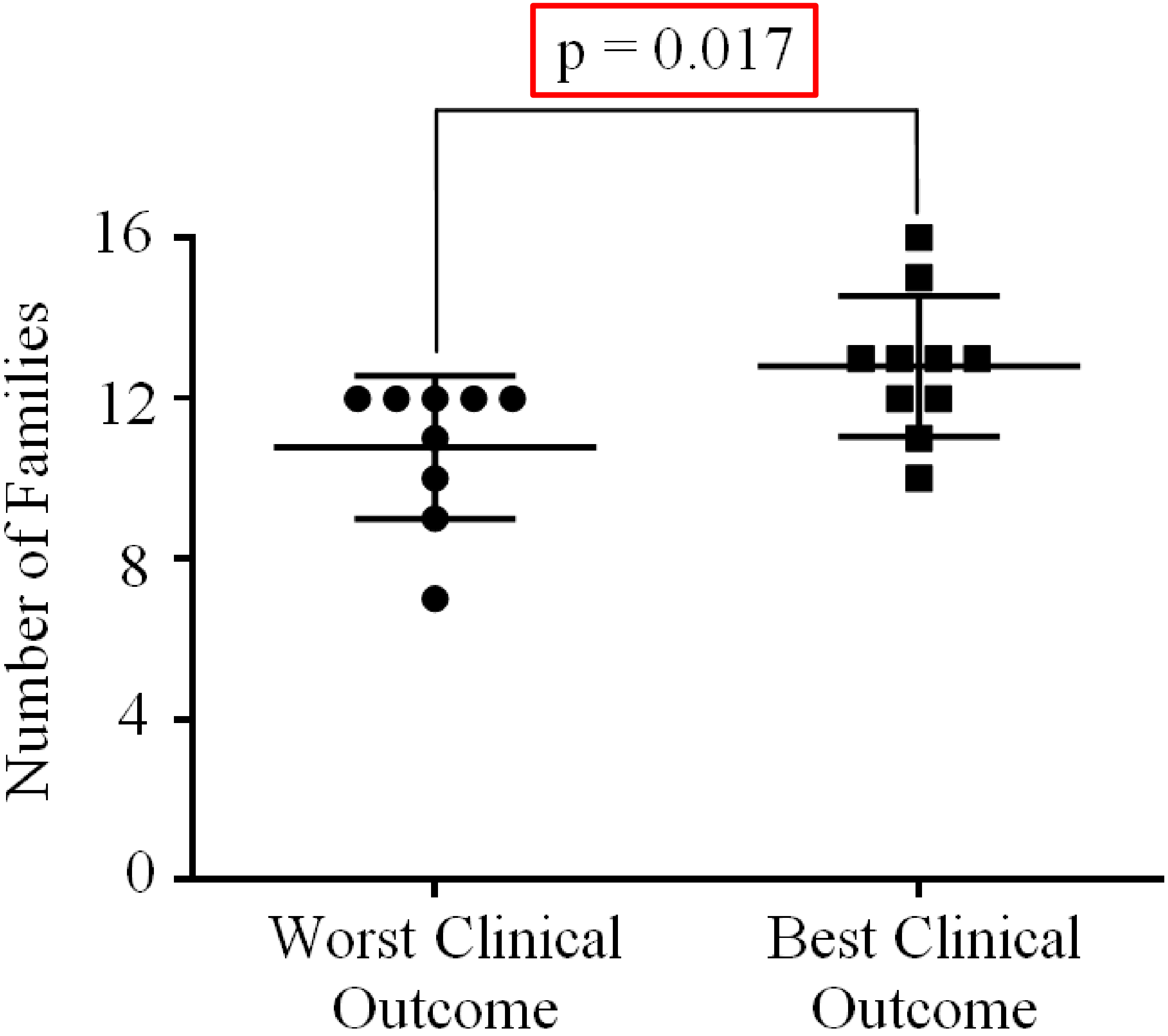
Lawrence Livermore Microbial Detection Array

Detects all sequenced microbes

3,856 viruses, 3,855 bacteria, 254 archaebacteria, 100 fungi, 36 protozoa



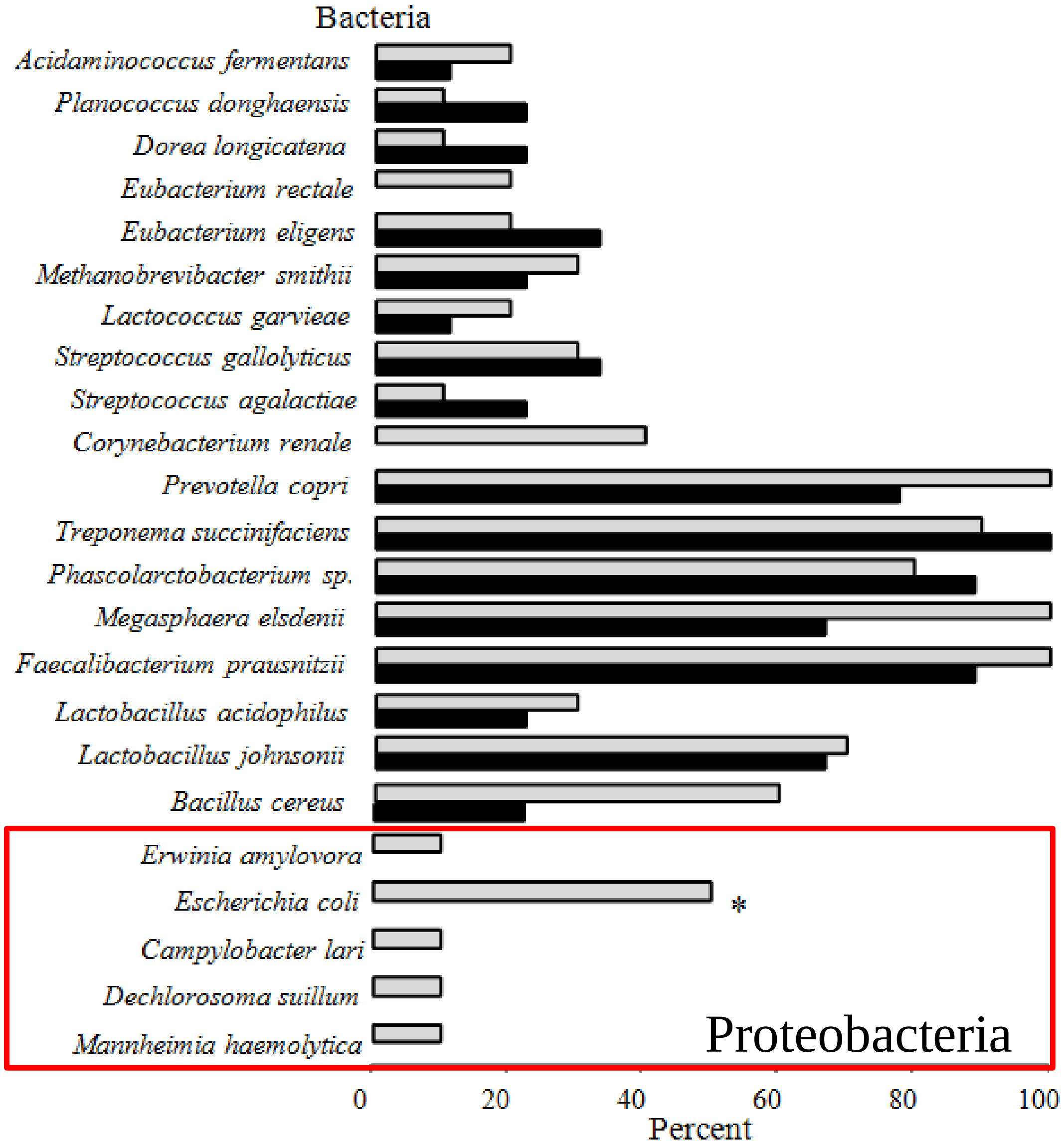
Microbiome Diversity



Niederwerder et al., 2016

Microbiome Composition

▬ Worst Clinical Outcome ▭ Best Clinical Outcome



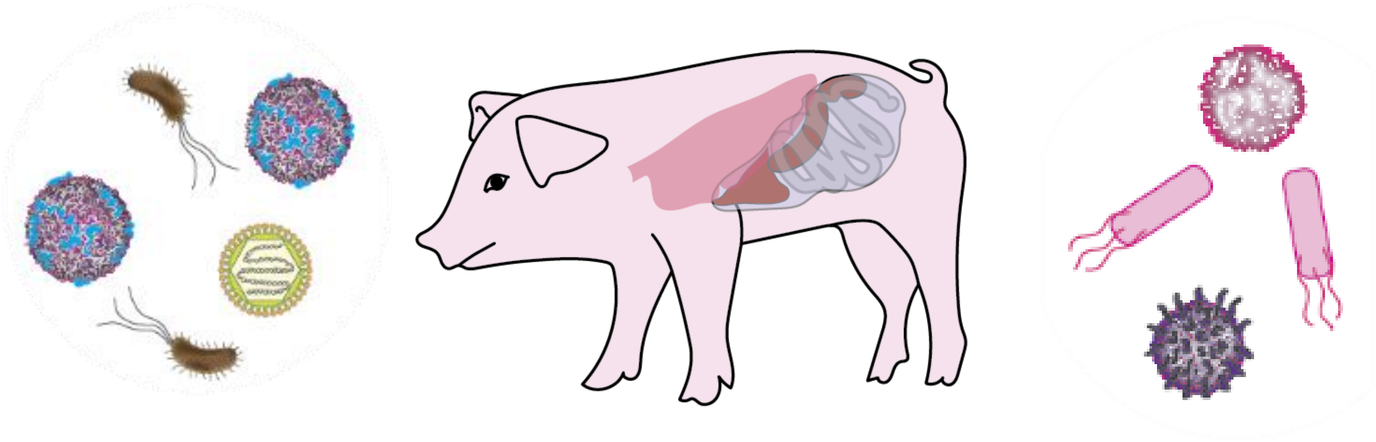
Niederwerder et al., 2016

Summary

1. Increased microbiome diversity
2. Increased fecal *Escherichia coli*

Associated with best clinical outcome **70 days** after PRRSV/PCV2 co-infection

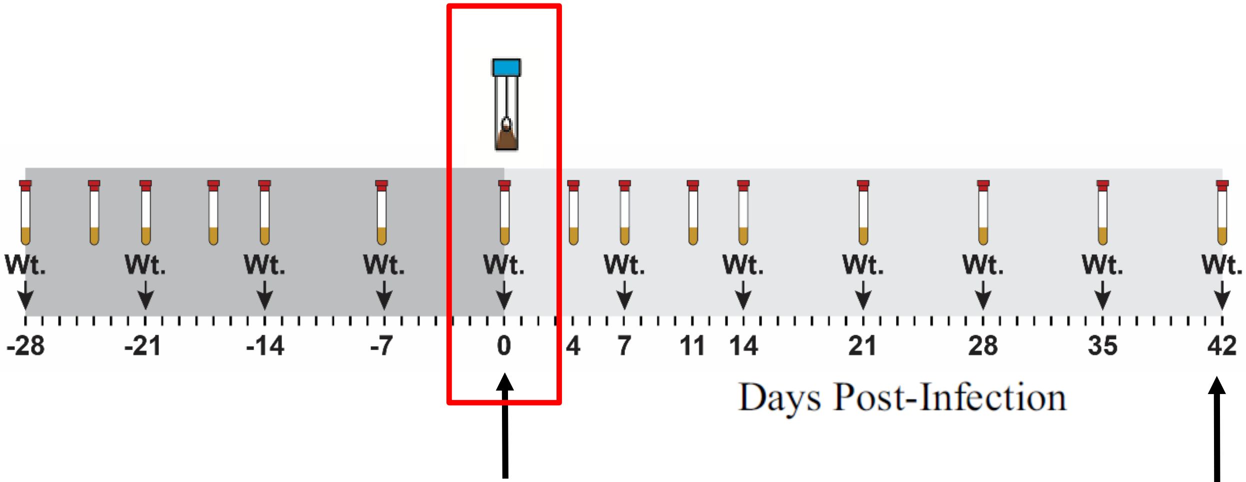
Do microbiome characteristics **PREDISPOSE** outcome following PRRSV/PCV2 co-infection?



Experimental Design

n = 50

9-10 pigs/pen

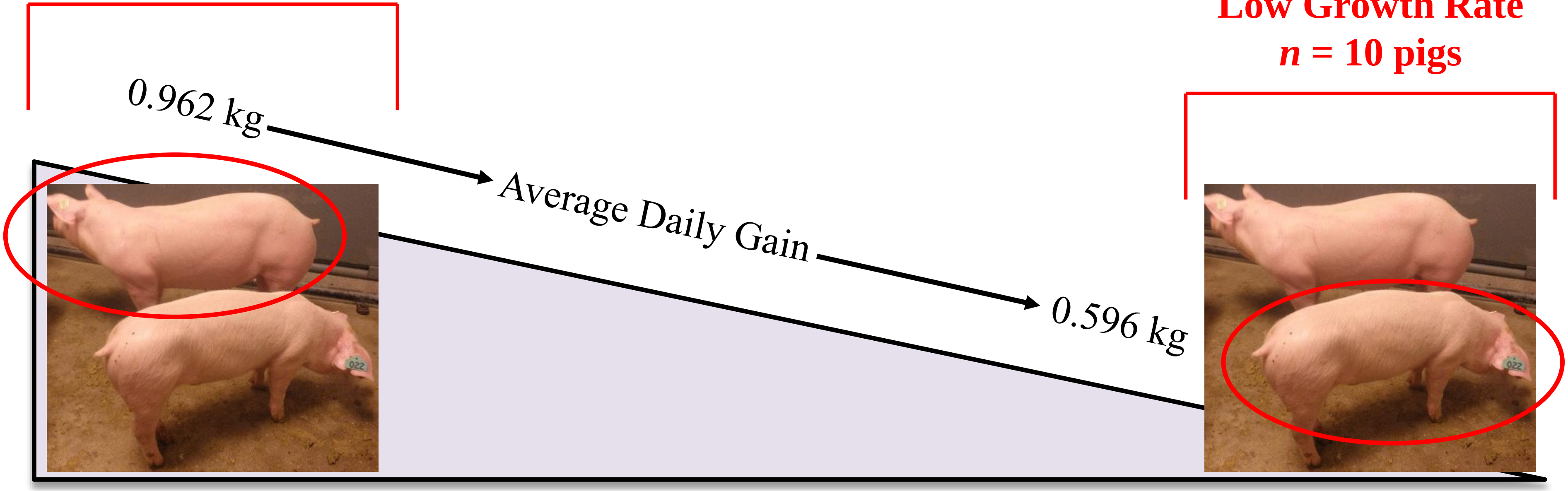


Days Post-Infection

PRRSV/PCV2 Challenge

20 Pigs Selected for High and Low Growth Rates

Selection of Pigs



High Growth Rate
***n* = 10 pigs**

0.962 kg

Average Daily Gain

0.596 kg

Low Growth Rate
***n* = 10 pigs**

0 days ← Clinical Disease → 0 days

Summary

1. Increased microbiome diversity
2. Increased fecal *Streptococcaceae*
3. Increased fecal *Ruminococcaceae*
4. Decreased fecal *Methanobacteriaceae*

On **day 0** is associated with high growth rates after PRRSV/PCV2 co-infection

Characteristics of Improved Outcome

↑ MICROBIAL DIVERSITY

↓ *Methanobacteriaceae*

↑ *Streptococcus sp.*

↑ *Escherichia coli*

↑ *Ruminococcus sp.*

↑ Average Daily Gain

↓ Interstitial Pneumonia

↓ Clinical Disease

↓ PRRSV Viremia

Conclusion

The microbiome may be used as an **ALTERNATIVE TOOL** and novel intervention strategy for management of infectious disease in swine

Acknowledgements

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