

HQP23 LATAM



What are the challenges for Intestinal health?

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“Take care of your gut first,
and it will take care of
everything else.”



Ashta Churnam
Powder

Dr. Yadu Moss
TEDx Talks - June 2023



AN TOAN LA TRÊN H



Immune system

Intestinal barrier

Microbiome

PIG PROGRESS

Pigs ▾

Health/Nutrition ▾

Markets

Piglet gut health: An economic proposition

06-03-2020 | [Health](#) | [Health/Nutrition](#) | [Article](#)





What are the challenges for Intestinal health?

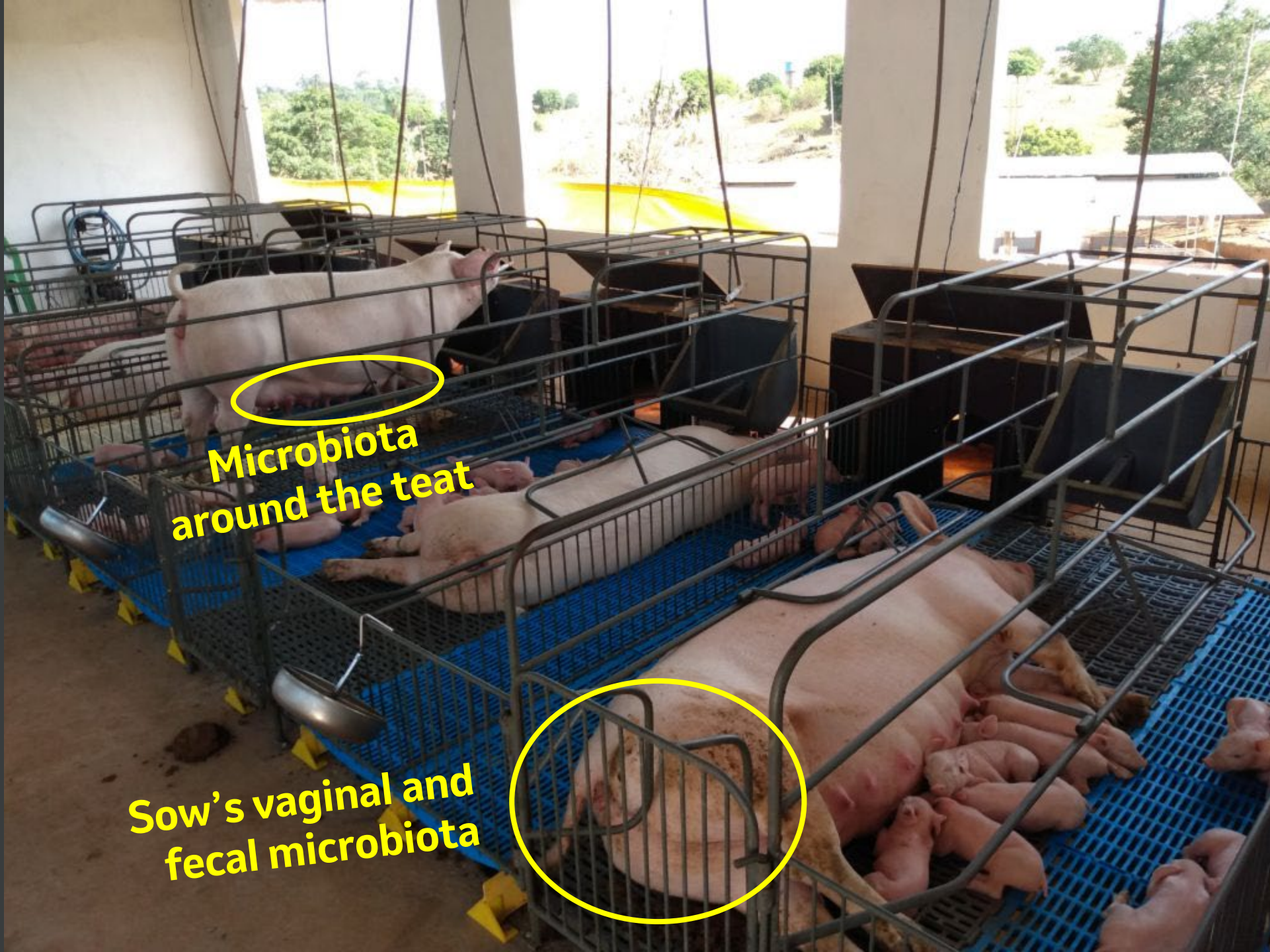




Early life events impact the whole life of the pigs?

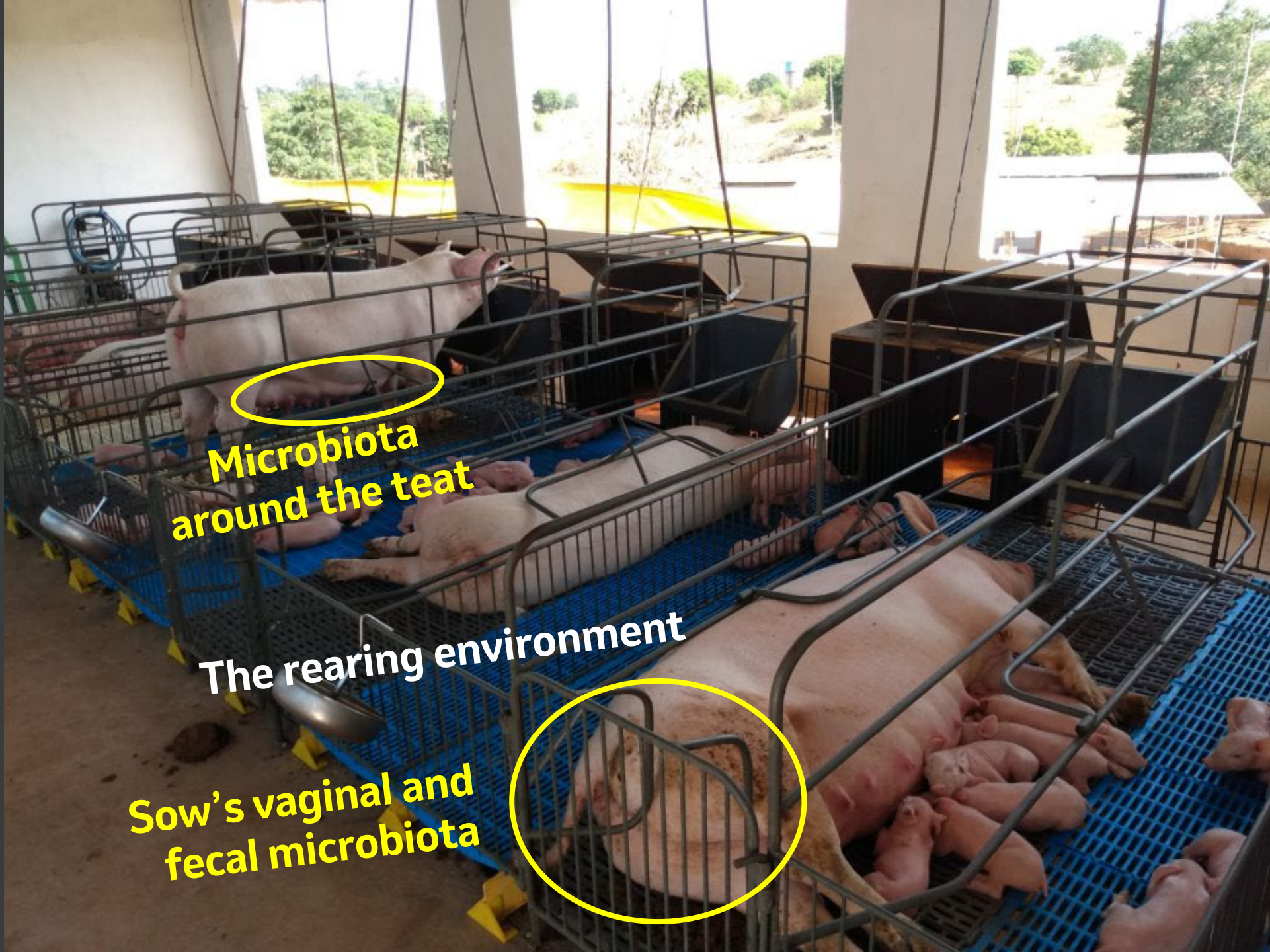
“Early-life microbial colonization is the most important time for shaping intestinal and immune development”

“Perturbations to the microbiota during this time having long-lasting negative implications for the host”



**Microbiota
around the teat**

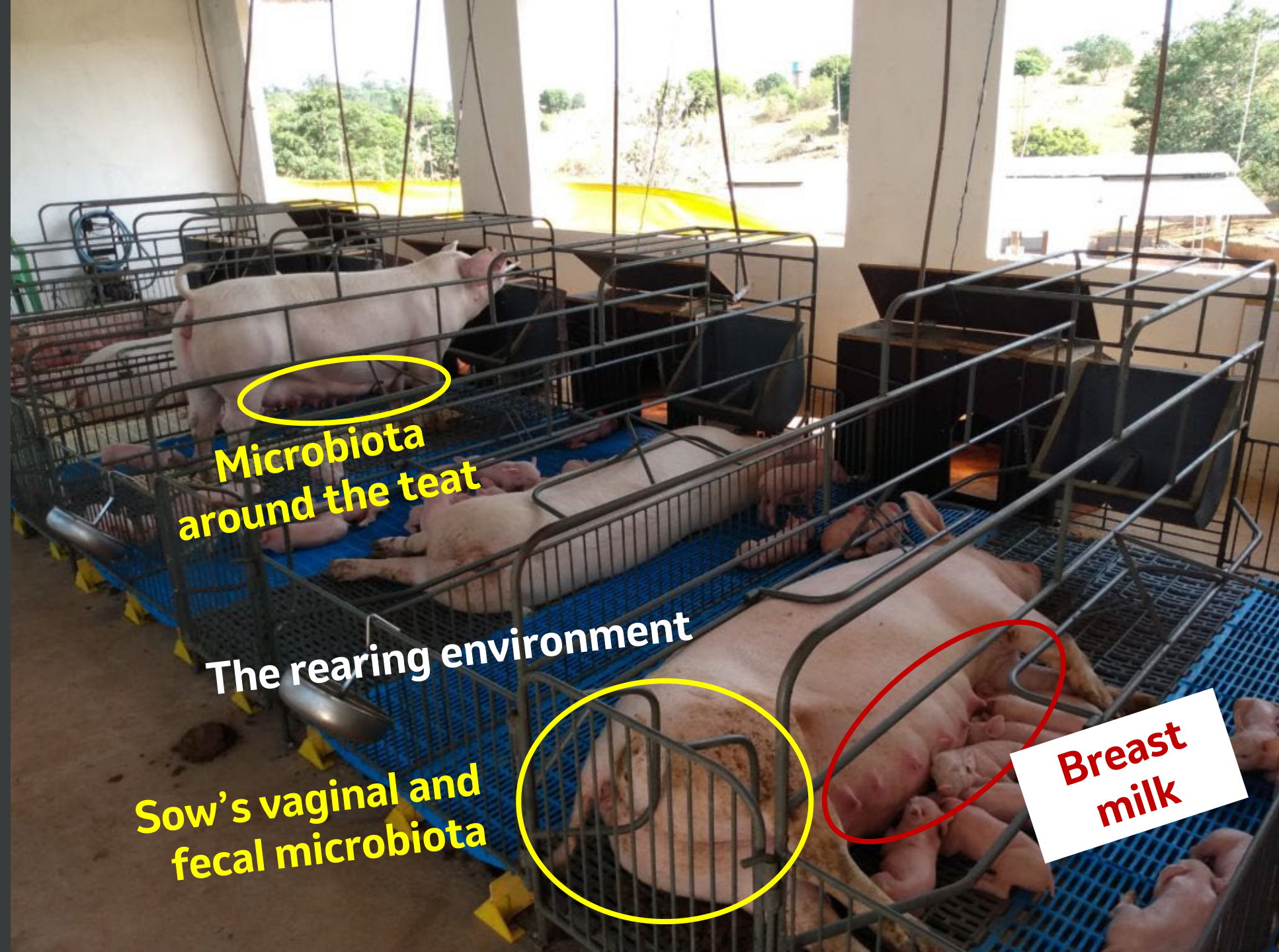
**Sow's vaginal and
fecal microbiota**



Microbiota
around the teat

The rearing environment

Sow's vaginal and
fecal microbiota

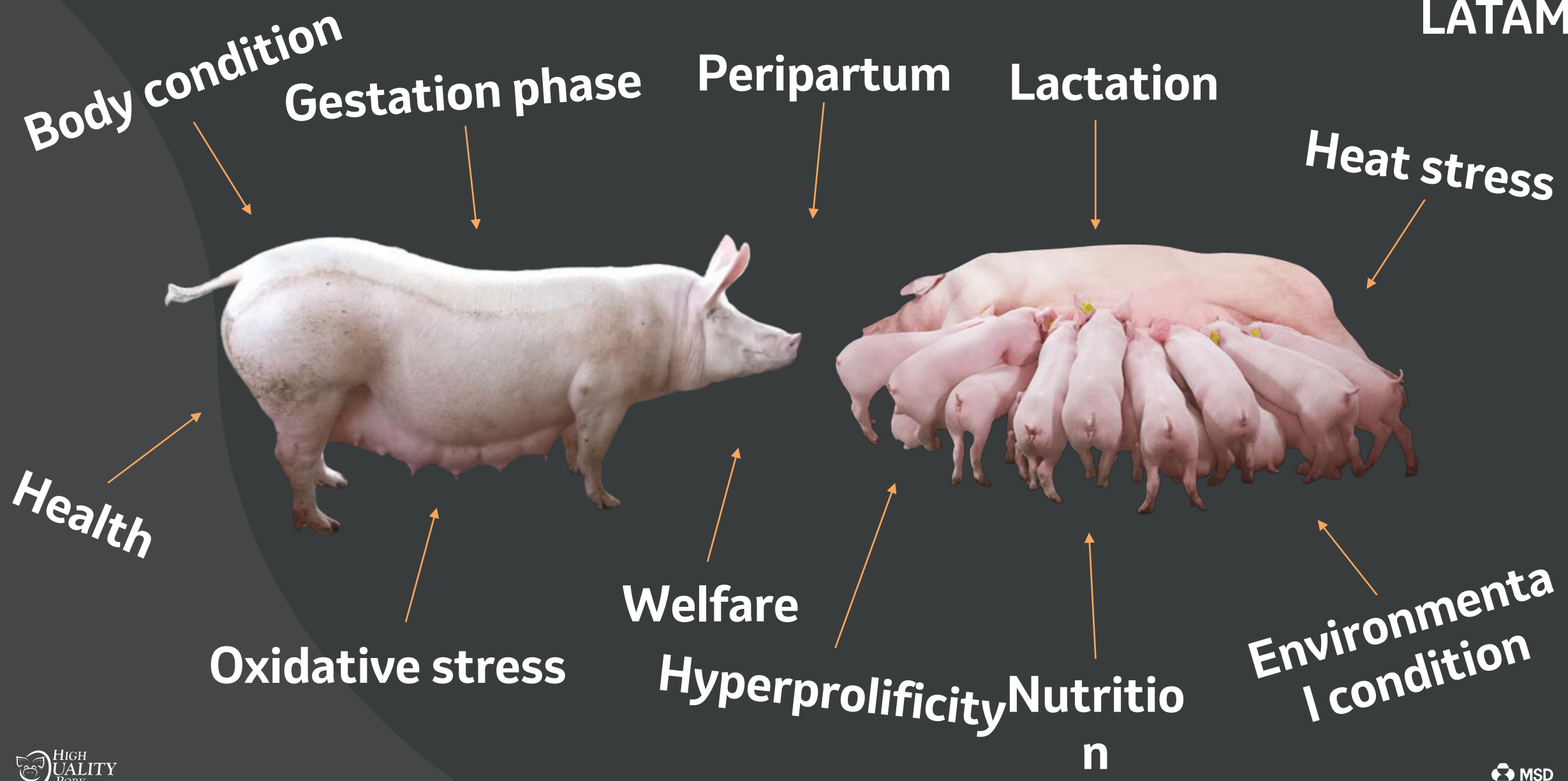


Microbiota
around the teat

The rearing environment

Sow's vaginal and
fecal microbiota

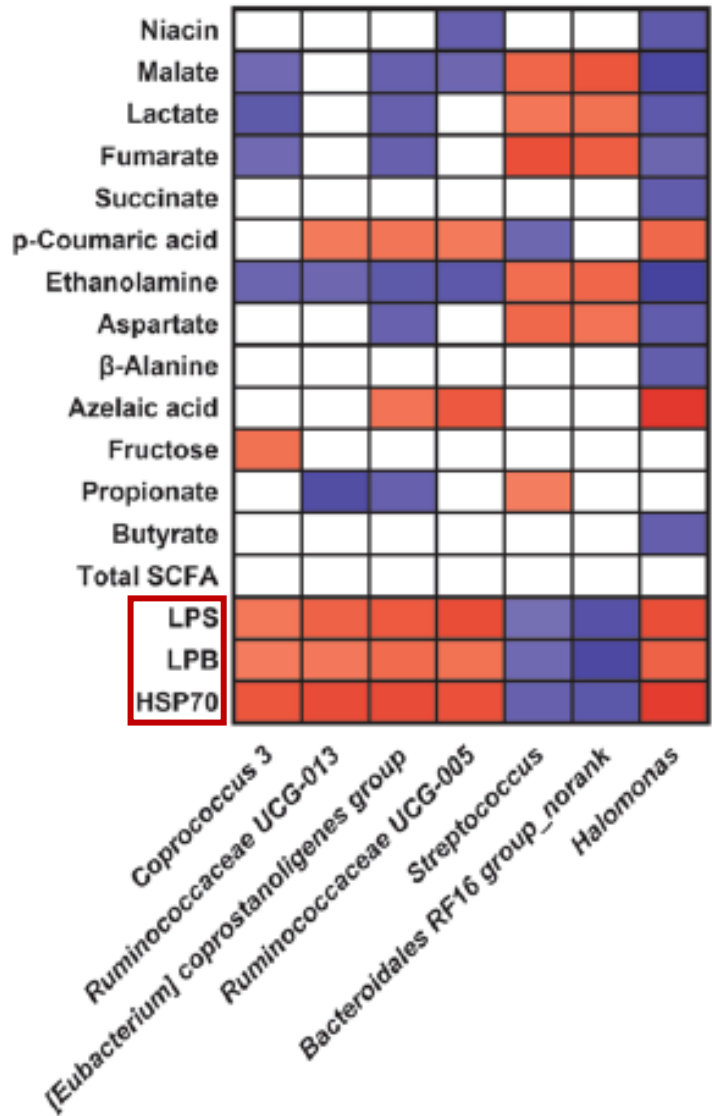
Breast
milk





HS-induced maternal microbial and metabolic changes during late gestation

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■ Positive correlation
 ■ Negative correlation
 HS = 28–32 °C;
 HS sows: n = 6

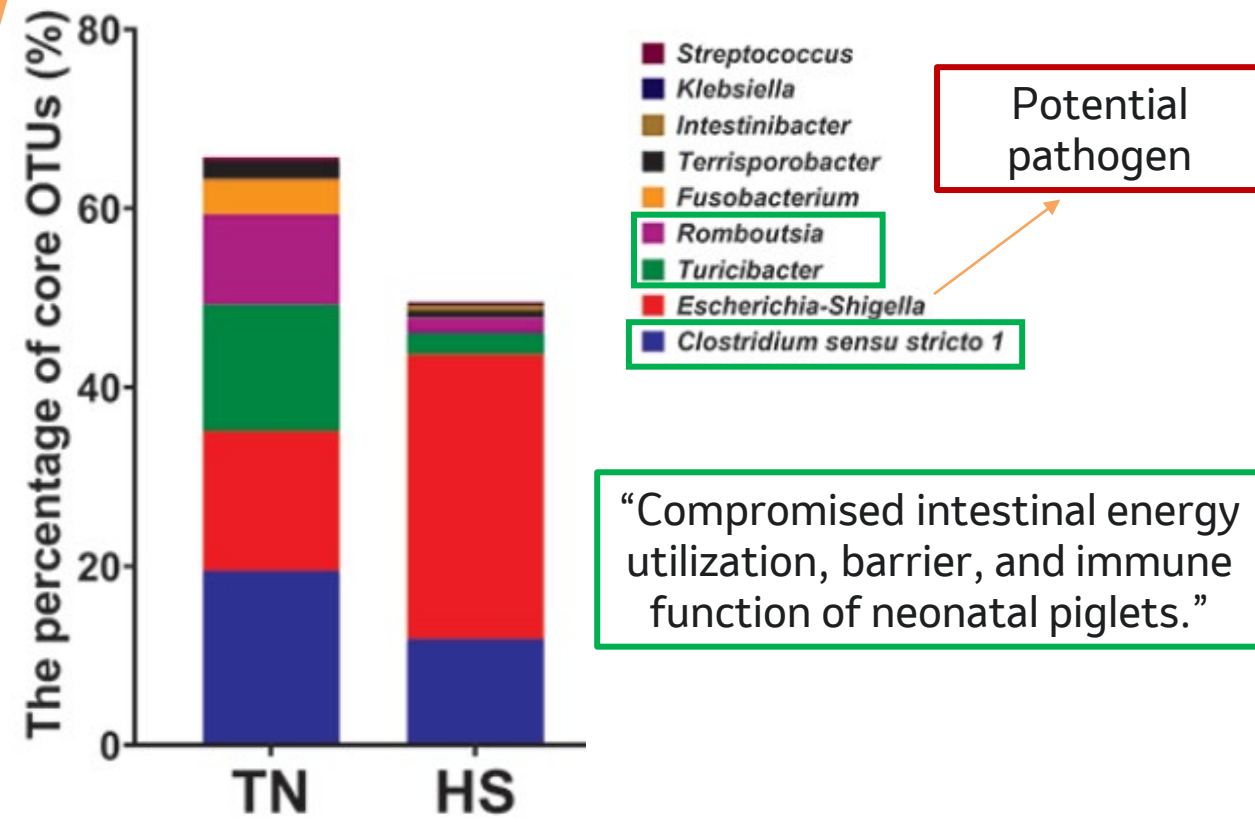




HEAT STRESS

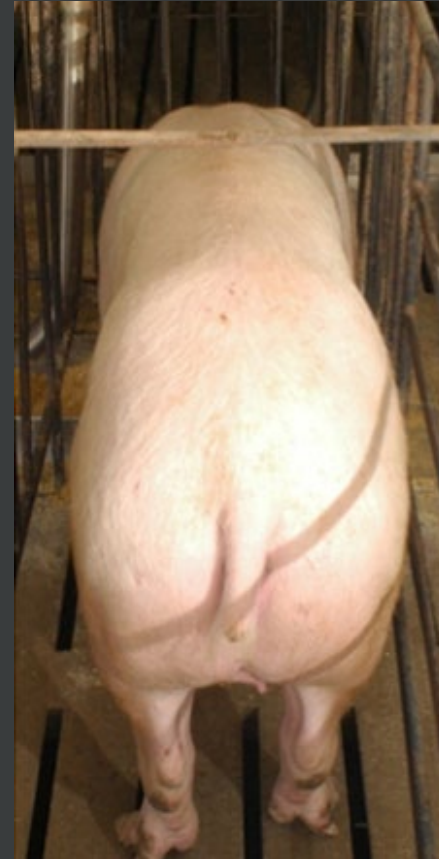
HS-disrupts maternal microbial transmission

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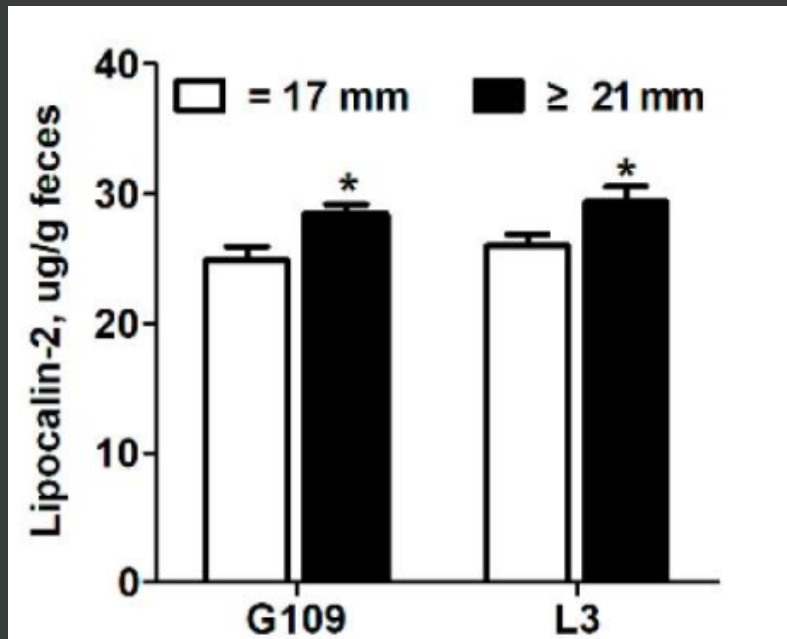
TN: (18-22°C; n=6)
 HT: (28-32°C; n=6)

Does the sow's body condition interfere with intestinal health?

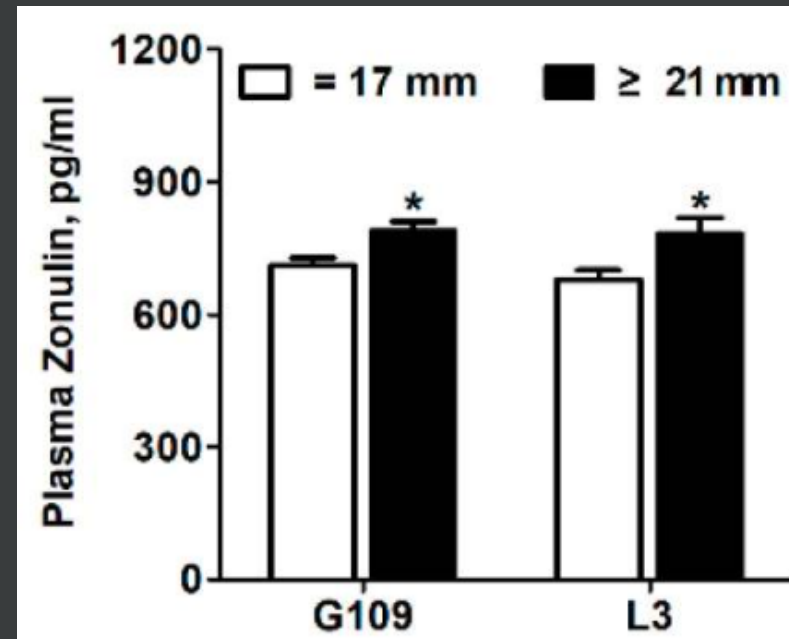


Hog Slat site

Excessive backfat thickness during late pregnancy affects intestinal inflammation and intestinal permeability biomarkers in perinatal sows



Indicator of intestinal inflammation

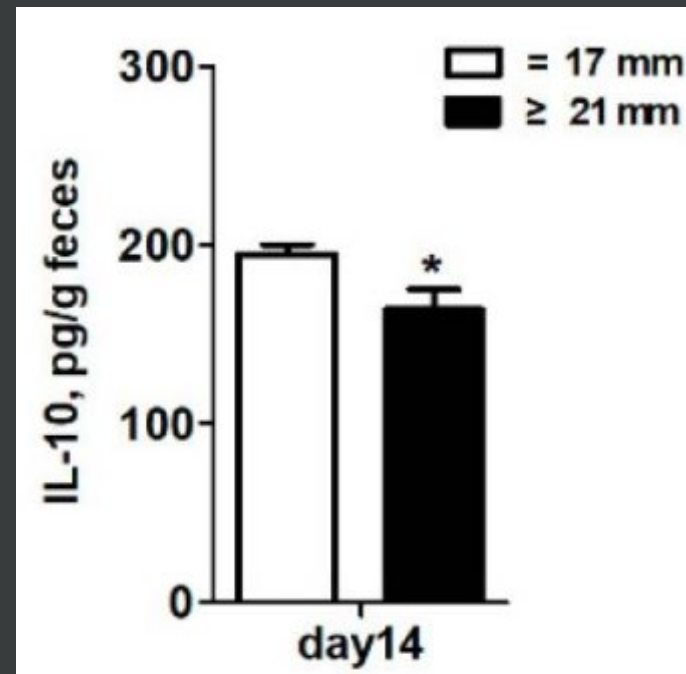
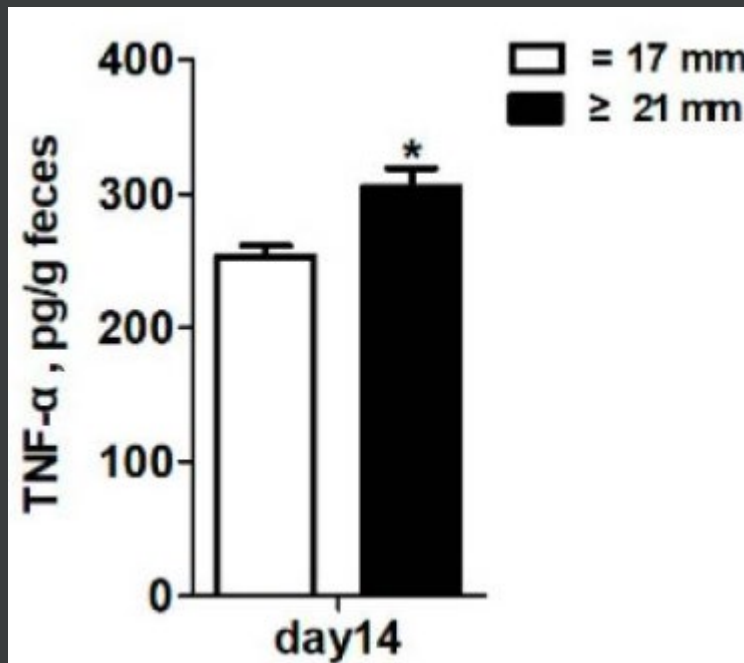


Reflect intestinal permeability

G109 = day 109 of pregnancy (n=30);

L3 = day 3 of lactation (n=30).

Excessive backfat thickness during late pregnancy affects intestinal inflammation cytokines in offspring piglets



Day14 = 14 days of lactation;

n = 60 piglets

The preventative use of antibiotics in early life

Early-Life Environmental Variation Affects Intestinal Microbiota and Immune Development in New-Born Piglets

2014

Dirkjan Schokker^{1,*}, Jing Zhang^{2,3}, Ling-li Zhang², Stéphanie A. Vastenhouw³, Hans G. H. J. Heilig², Hauke Smidt², Johanna M. J. Rebel³, Mari A. Smits^{1,3}

Parenteral single dose at **day 4** of age: affected the composition and diversity of gut microbiota and downregulated in chemokine and toll-like receptors at **day 8 after birth**.

Use of antibiotics at early age can affect the gut microbiota composition and diversity in one-week old piglets

2019

Shah Hasan, Olli Peltoniemi, Juhani Vuorenmaa, Claudio Oliviero

Two antibiotics within **3 days of life**: decrease relative abundance of not only **opportunistic pathogenic bacteria** (*Campylobacter*, *Pasteurella*), but also **beneficial bacteria** (*Prevotella*, *Butyrimonas*).



antibiotics



Article

Effects of Early Intervention with Antibiotics and Maternal Fecal Microbiota on Transcriptomic Profiling Ileal Mucosa in Neonatal Pigs

2020

Rongying Xu^{1,2}, Jiajia Wan^{1,2}, Chunhui Lin^{1,2} and Yong Su^{1,2,*}

Oral atb at **1-6 days of age**: **negative effect** on **intestinal morphology** at d 7, altered **gene expression profiles** in the ileum at d 7 and 21 of age, and **upregulated chemokines** on day 21.



animals



Article

Faecal Microbiota Analysis of Piglets During Lactation

2020

Tanya L. Nowland^{1,*}, Valeria A. Torok², Wai Y. Low³, Mary D. Barton⁴, Kate J. Plush⁵ and Roy N. Kirkwood¹

Parenteral antibiotic at **7 days of age**: **no impacts** on the fecal microbiota.

Long term effects?


 The ISME Journal (2007) 1, 180–183
© 2007 International Society for Microbial Ecology All rights reserved 1751-7362/07 \$30.00
www.nature.com/ismej

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7

SHORT COMMUNICATION
Parenteral long-acting amoxicillin reduces intestinal bacterial community diversity in piglets even 5 weeks after the administration

Pawel Janczyk^{1,4}, Robert Pieper^{1,4}, Wolfgang Bernhard Souffrant¹, Diane Bimczok², Hermann-Josef Rothkötter² and Hauke Smidt³

Atb administration at **1 day of age**: altered its colonic microbiota composition up to at least **5 weeks of age**.

 PLOS ONE

2015

RESEARCH ARTICLE

Long-Lasting Effects of Early-Life Antibiotic Treatment and Routine Animal Handling on Gut Microbiota Composition and Immune System in Pigs

Dirkjan Schokker^{1*}, Jing Zhang², Stéphanie A. Vastenhouw³, Hans G. H. J. Hellig², Hauke Smidt², Johanna M. J. Rebel², Mari A. Smits^{1,3}

Parenteral atb at **4 day of age** had **long-lasting effects** on the gut: **higher expression of ileal tissue immune-related genes at day 55**, and **lower microbiota diversity at day 176**.

 animals

2019 

Article

Early Parenteral Administration of Ceftiofur has Gender-Specific Short- and Long-Term Effects on the Fecal Microbiota and Growth in Pigs from the Suckling to Growing Phase

Ursula Ruczizka¹, Barbara Metzler-Zebeli^{2,*}, Christine Unterwieser¹, Evelyne Mann³, Lukas Schwarz¹, Christian Knecht¹ and Isabel Hennig-Pauka^{1,4}

Parenteral atb **12h post partum**: differences in the fecal microbiota of piglets at **12, 28 and 97 days**. **Markedly affected microbial diversity** in the fecal microbiota composition, with long-term consequences for **performance**.

The effect of maternal antibiotic use in sows on intestinal development in offspring 

Astrid de Greeff, Dirkjan Schokker ✉, Petra Roubos-van den Hil, Peter Ramaekers, Stephanie A Vastenhouw, Frank Harders, Alex Bossers, Mari A Smits, Johanna M J Rebel

Author Notes

Journal of Animal Science, Volume 98, Issue 6, June 2020, skaa181,

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Sow in feed antibiotic during **last 7 days of gestation**: changes in the **sow's fecal microbiota diversity**; negatively affected **small intestine morphology development** in piglets **up to 5 weeks of age**.



Animal welfare and intestinal health

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“Pigs kept in **crowded, barren conditions**, with **poor microclimatic conditions**, and subject to **painful and stressful practices** present redirected behaviours, poor immune-competence, and weaker bodies”.

Albernaz-Gonçalves et al. (2022)



“**Environmental and psychosocial stressors** play a central role in the initiation and (or) exacerbation of common and burdensome intestinal disorders of humans and animals”.

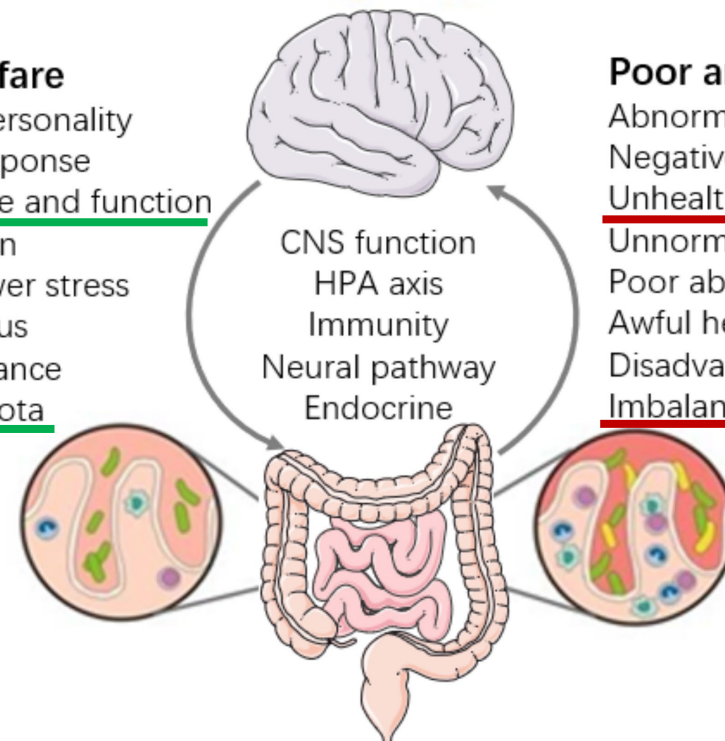
Li et al. (2017)

Good animal welfare

- Normal behavior, personality
- Positive immune response
- Healthy gut structure and function
- Normal CNS function
- Good ability to answer stress
- Excellent health status
- Advantage performance
- Balance gut microbiota

Poor animal welfare

- Abnormal behavior, personality
- Negative immune response
- Unhealthy gut structure and function
- Unnormal CNS function
- Poor ability to answer stress
- Awful health status
- Disadvantage performance
- Imbalance gut microbiota



Chen et al (2021)

Chronic mixing/crowding stress at weaning

PLOS ONE

OPEN ACCESS PEER-REVIEWED
RESEARCH ARTICLE

2017

Chronic social stress in pigs impairs intestinal barrier and nutrient transporter function, and alters neuro-immune mediator and receptor expression

Yihang Li, Zehe Song, Katelyn A. Kerr, Adam J. Moeser

Published: February 7, 2017 • <https://doi.org/10.1371/journal.pone.0171617>

Significant alterations in intestinal barrier and nutrient transport function.

Social stress at weaning



202

Influence of body lesion severity on oxidative status and gut microbiota of weaned pigs

F. Correa^a, D. Luise^a, G. Palladino^b, D. Scicchitano^b, P. Brigidi^c, P.L. Martelli^b, G. Babbi^b, S. Turrone^b, G. Litta^d, M. Candela^b, S. Rampelli^b, P. Trevisi^{a,*}

Social stress due to body lesion disrupts homeostasis and affects gut microbiota

Tail-biting at growing/finishing phase

frontiers
in Veterinary Science

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Association Between Tail-Biting and Intestinal Microbiota Composition in Pigs

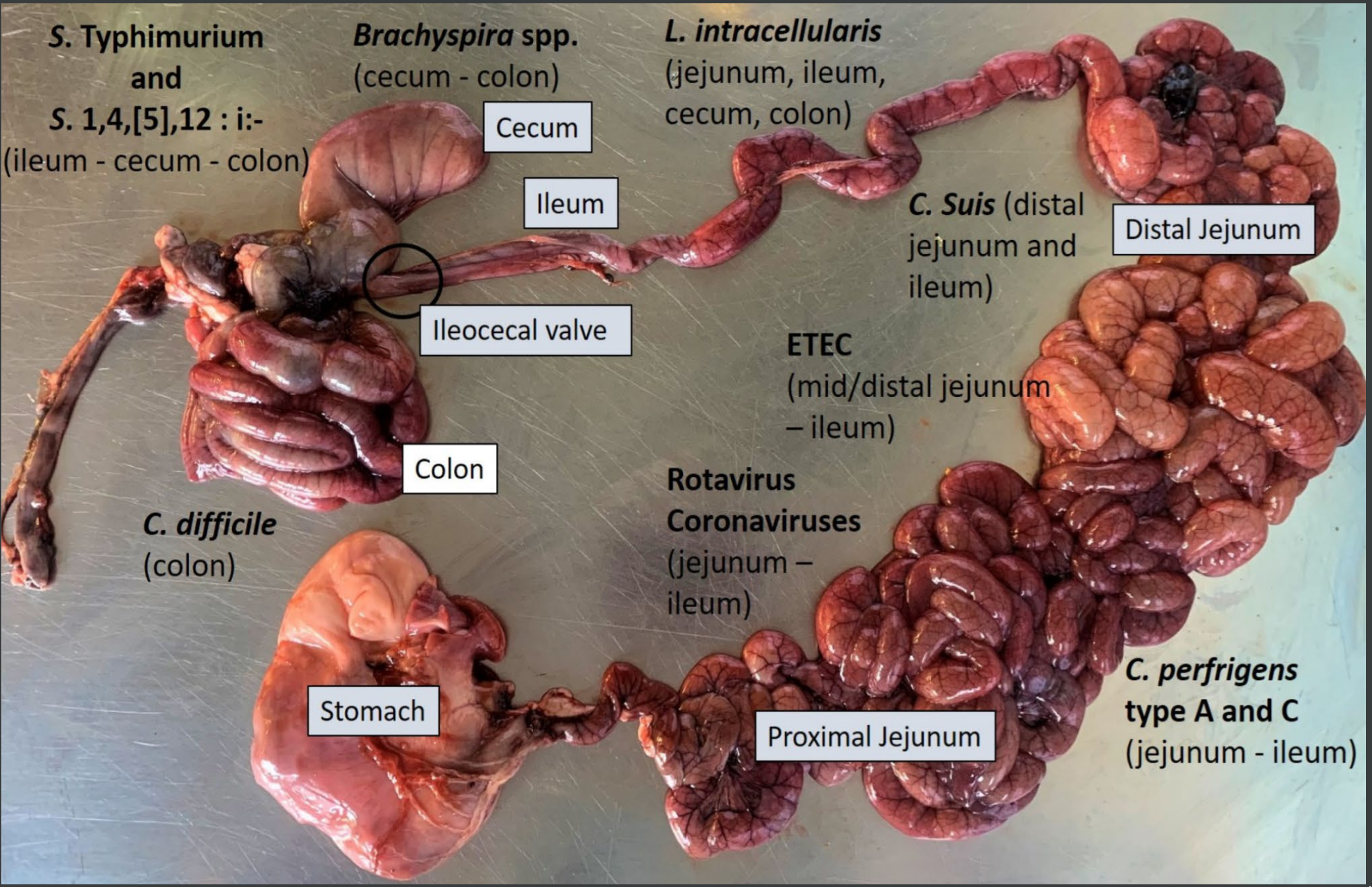
Nassima Rabhi^{1,2}, Alexandre Thibodeau^{1,2}, Jean-Charles Côté^{1,2}, Nicolas Devillers³, Benoit Laplante⁴, Philippe Fravalo^{1,2}, Guillaume Larivière-Gauthier^{1,2}, William P. Thériault^{1,2}, Luigi Faucitano³, Guy Beauchamp^{1,2} and Sylvain Quessy^{1,2*}

Tail biter and bitter pigs: more stressed and altered microbiota composition.

The challenge of enteric diseases










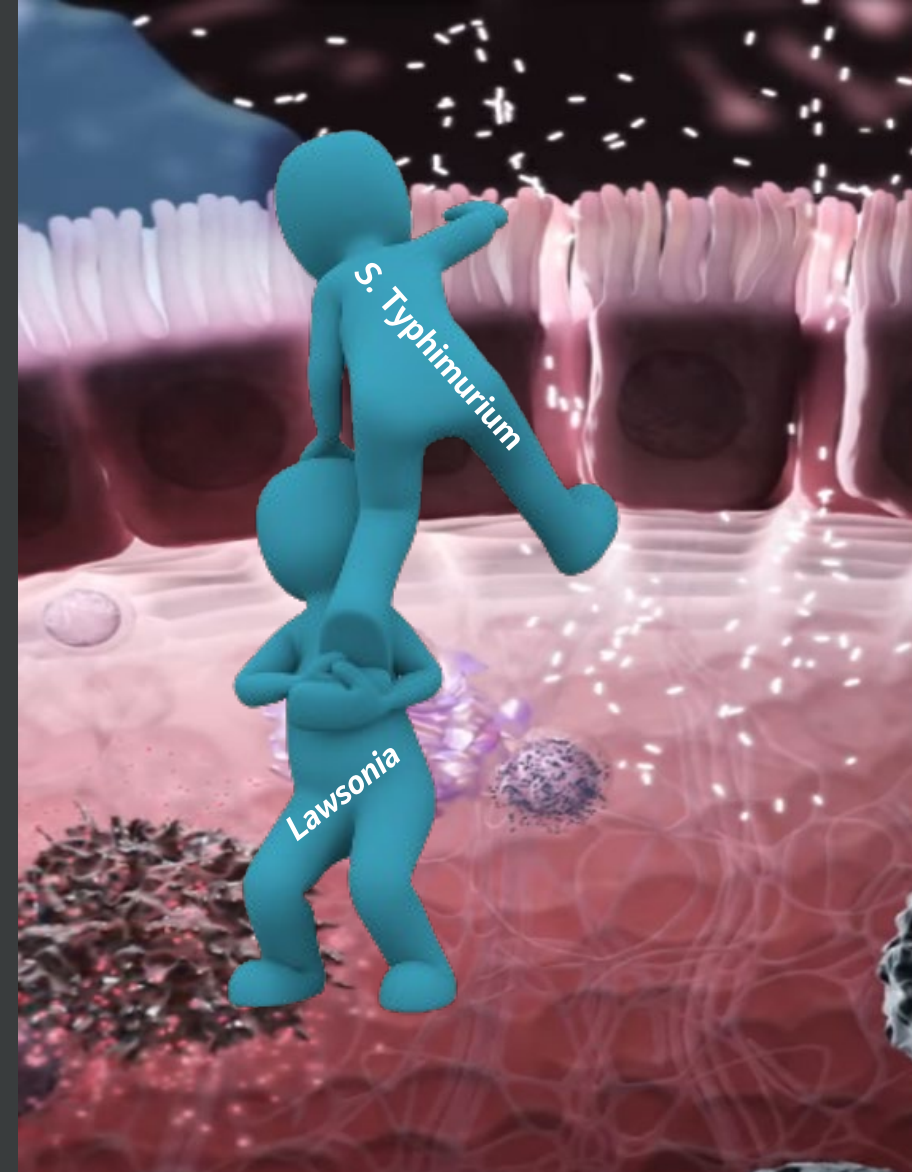
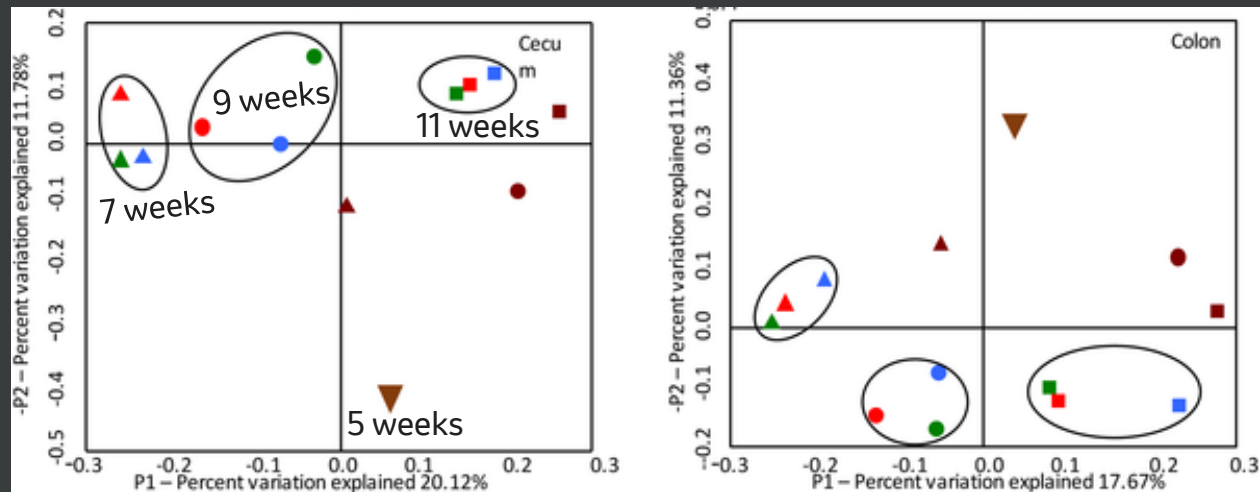
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

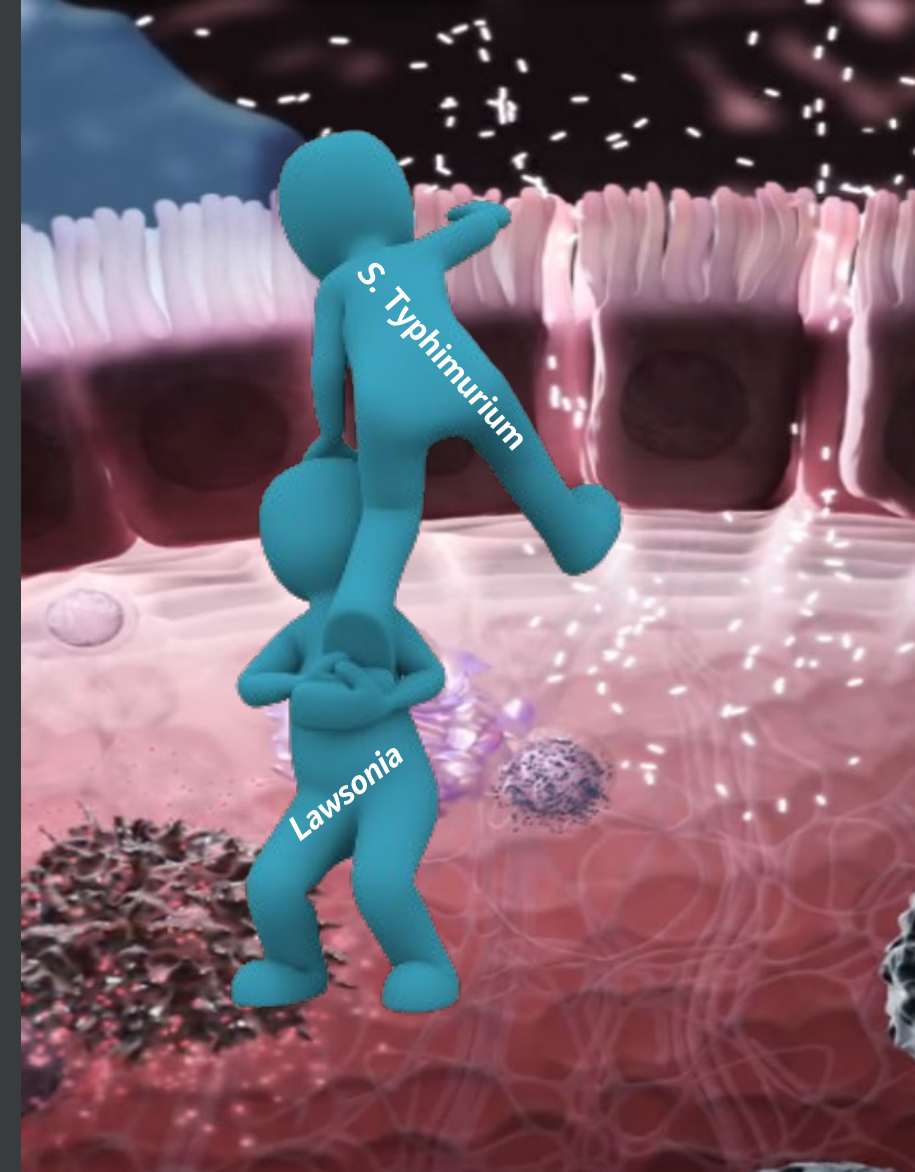
Changes in the Porcine Intestinal Microbiome in Response to Infection with *Salmonella enterica* and *Lawsonia intracellularis*

Klaudyna A. Borewicz , Hyeun Bum Kim , Randall S. Singer, Connie J. Gebhart, Srinand Sreevatsan, Timothy Johnson, Richard E. Isaacson 

Published: October 13, 2015 • <https://doi.org/10.1371/journal.pone.0139106>



Similar colonic and cecal microbiome composition.



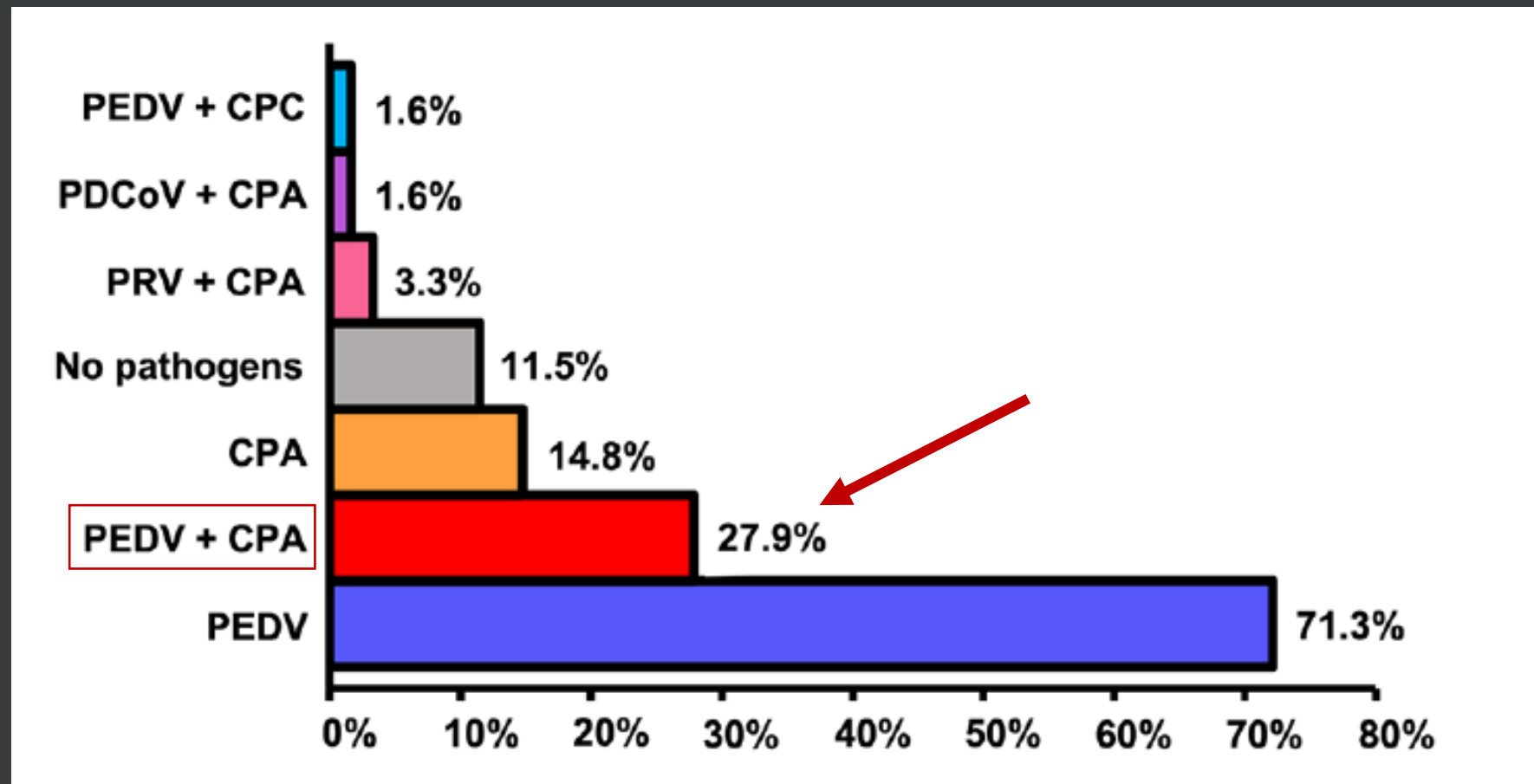
L. intracellularis leads to increased expression of IL-8 and TNF- α and has an additive effect on their expression in co-infection.



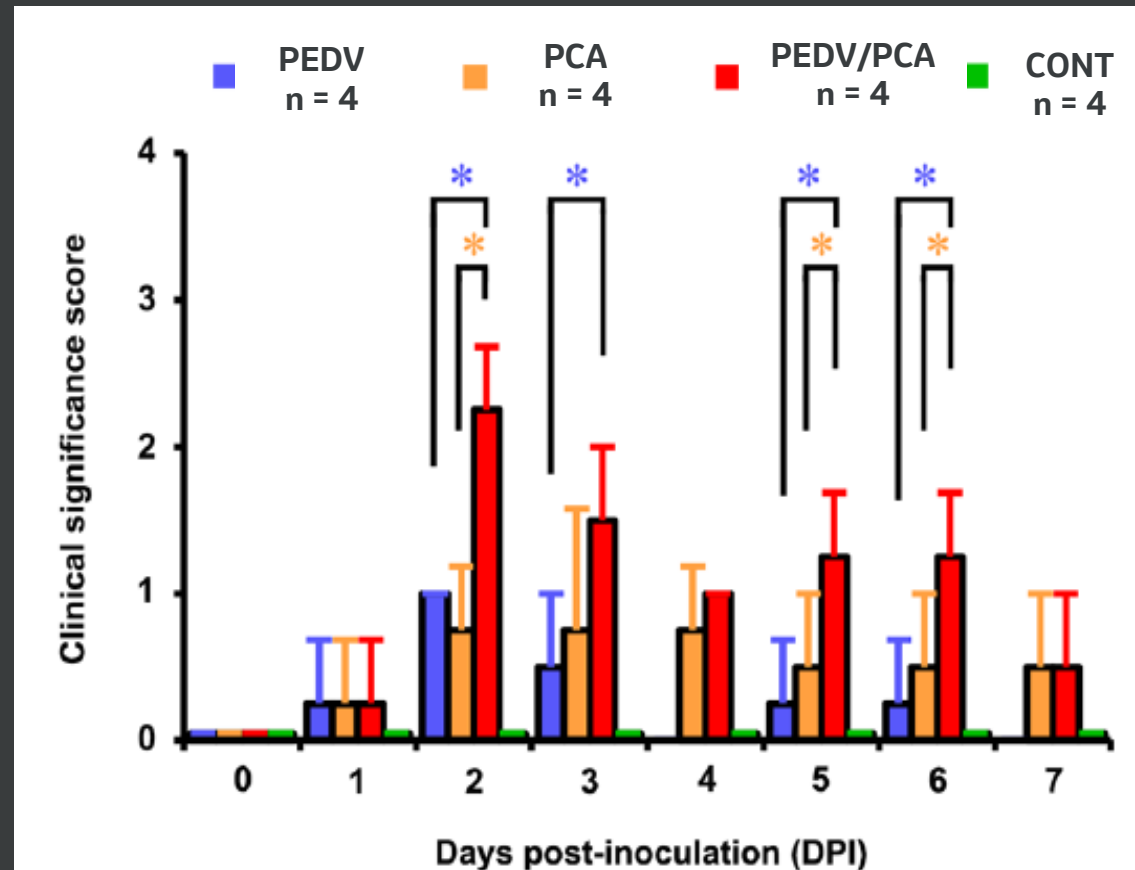
One mechanism by which *L. intracellularis* favors *S. Typhimurium* infection.

Coinfection with PEDV and *Clostridium perfringens* type A enhances disease severity in weaned pigs

- 61 farms in South Korea;
- Fecal samples ($n = 203$) of affected piglets (2-4 weeks of age);
- Collected from Jan 2021 - Jan 2022.



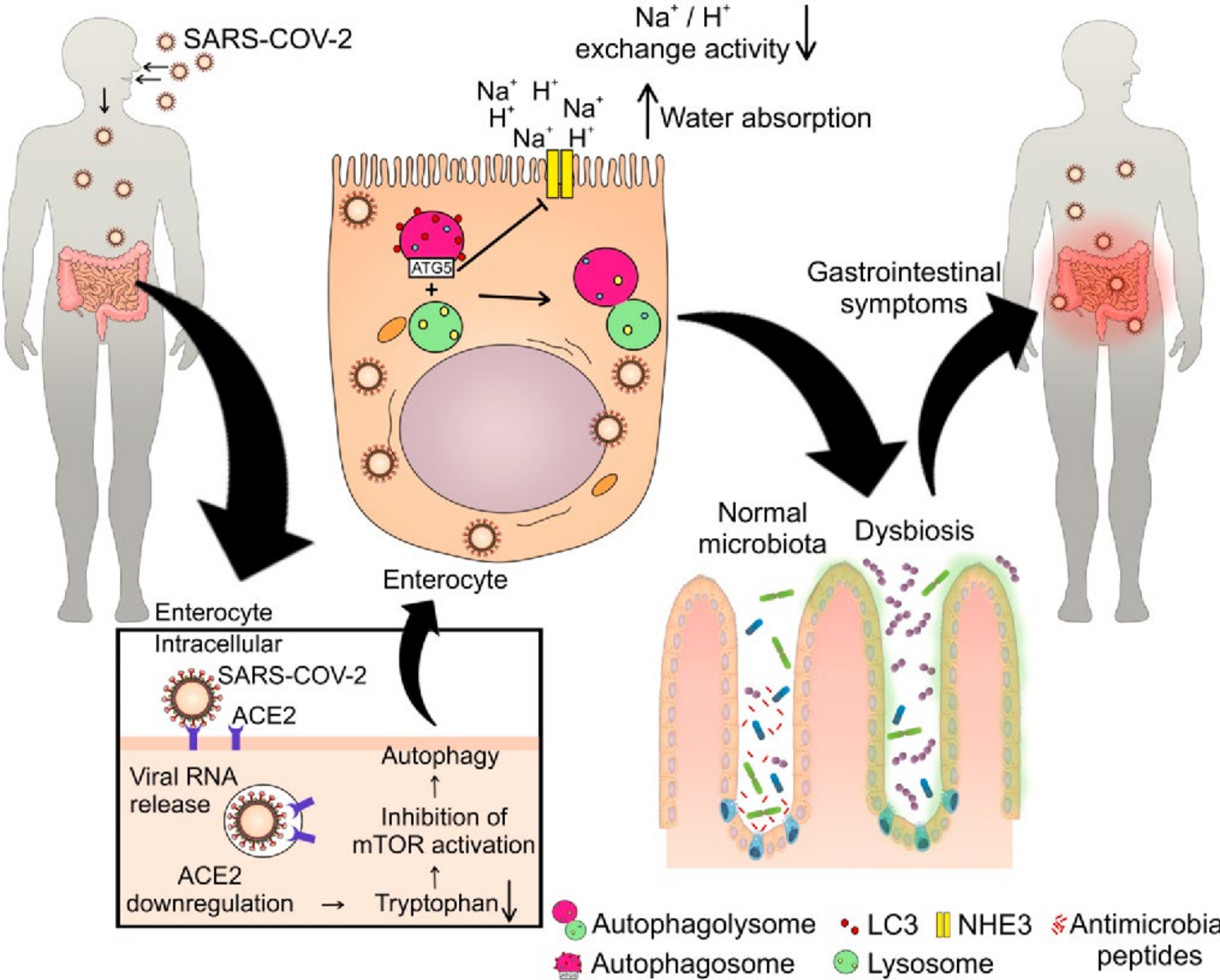
Coinfection with PEDv and *Clostridium perfringens* type A enhances disease severity in weaned pigs



Inoculation: 21 days of age
Evaluation: 7 days



Cross talk between the lung and the gut



COVID-19 and intestinal dysbiosis



Dysbiosis of Gut Microbiota and Intestinal Barrier Dysfunction in Pigs with Pulmonary Inflammation Induced by *Mycoplasma hyorhinis* Infection

Yingying Zhang,^a Yuan Gan,^b Jia Wang,^b Zhixin Feng,^b Zhaoxin Zhong,^c Hongduo Bao,^{a*} Qiyan Xiong,^b Ran Wang^{a*}

Perturbations of gut microbiome and metabolome of pigs infected with *Mycoplasma hyorhinis*

Yingying Zhang,^a Yuan Gan,^b Hongduo Bao^{a*} and Ran Wang^{a*}

Gut microbial dysbiosis ↑
(Opportunistic pathogens)

Immunomodulatory proteins
(Intestinal proteomic alterations)
↑

Barrier function
(D-lactate and Dao) ↓

n = 12
Day 42



Bama miniature pigs

20 mL IP on day 19;
10 mL IV on day 20;
10 mL IN on day 21.
Total dose: 1 × 10⁹ CCU/pig.

Gut microbial dysbiosis ↑
(Opportunistic pathogens)

Gut metabolites

Small intestine: Lipid metabolism and amino acid metabolites ↑

Large intestine: Lipid metabolism and amino acid metabolites ↓

n = 10
Day 22



EN Get citation

JOURNAL ARTICLE
***Mycoplasma hyopneumoniae*–*Lawsonia intracellularis* dual challenge modulates intestinal integrity and function¹** FREE
 Emma T Helm, Shelby M Curry, Kent J Schwartz, Steven M Lonergan, Nicholas K Gabler ✉
Journal of Animal Science, Volume 97, Issue 6, June 2019, Pages 2376–2384, <https://doi.org/10.1093/jas/skz112>



MhLI, n = 12 pigs
Control, n = 12 pigs

Mh = 10 mL inoculum (1×10^5 color-changing units/mL) via intratracheal gavage.

LI = 40 mL inoculum (2 mL gut homogenate, with 2×10^7 LI) intragastrically.

↓ performance: ADG (38%, $P < 0.001$), ADFI (25%, $P < 0.001$), and G:F (19%, $P = 0.012$).

↑ ileal glucose transport (30%, $P = 0.05$) and ↓ sucrase activity (30%, $P = 0.049$).

Did NOT affect ileum morphology or transepithelial resistance ($P > 0.10$).

↑ translocation of *S. Typhimurium* in the colon.**

What challenges for intestinal health can we face in the coming years?



**We still engaged
in the progressive
reduction of
antibiotic use**



**But there is still a long
way to go.**

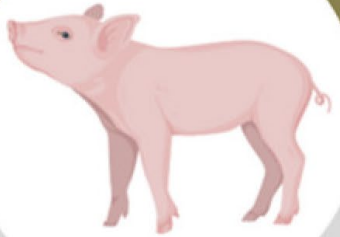
From post-weaning diarrhea **alternative** solution to the **banning** challenge



- June 2022: the use of pharmacological levels of ZnO in weaned piglet feed was banned in the EU.
- Only 150 ppm is allowed.

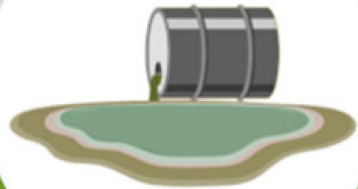


Why ZnO need to be replaced?



Toxicity effects

In case of too high or too prolonged administration



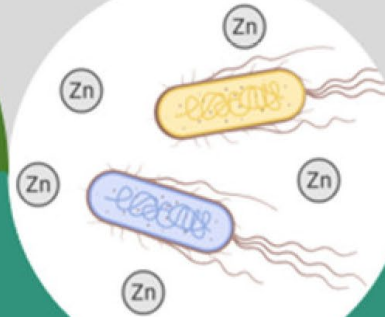
Environment

Pollution from zinc-rich manure application on fields



Antibiotics

Acceleration of antibiotic resistance genes spread



Heavy metals

Increase of heavy metal tolerance genes spread



Microbiota

Modification of bacterial population composition

What questions does the ZnO ban bring up?

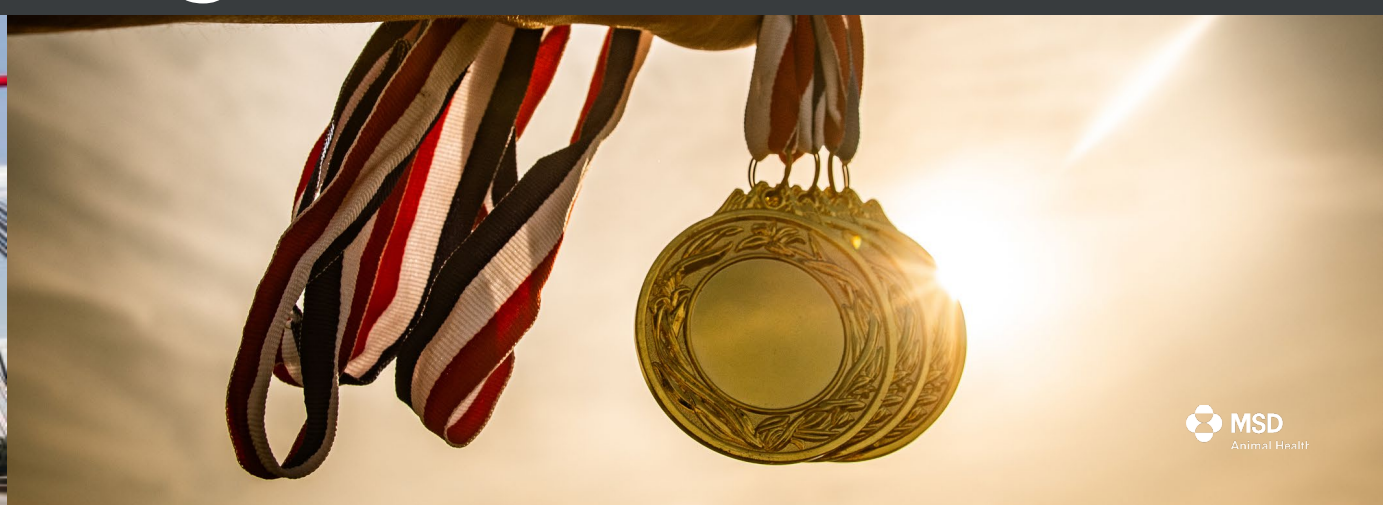
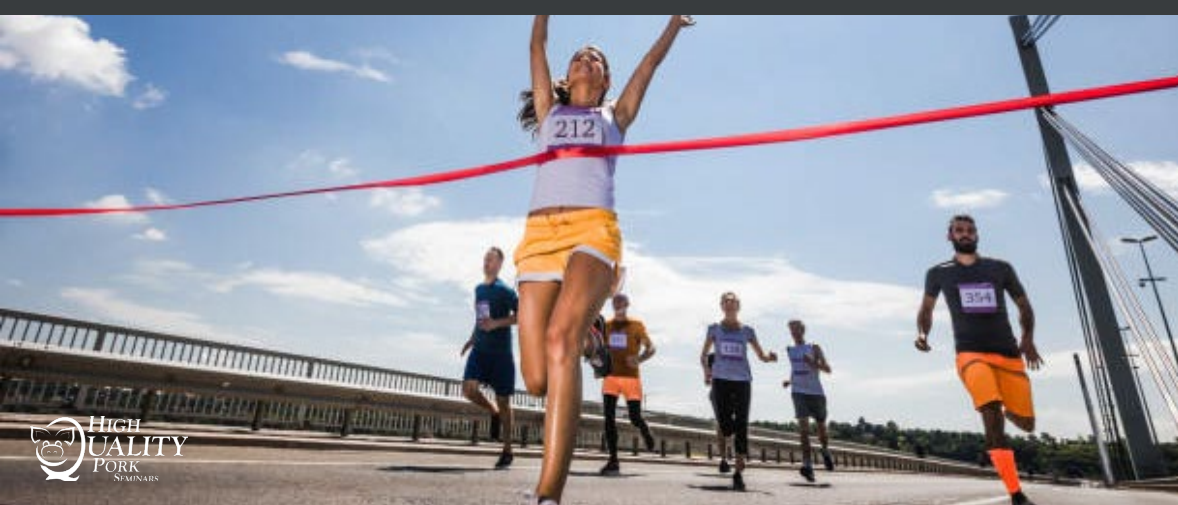
- What is the economic impact?
- Will it increase the need for antibiotics?
- What are the feed alternatives?
- What needs to change on the farm without ZnO?
- How is America looking at this? Do we have time to prepare for it?





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How to overcome the pig intestinal challenges?



The holistic approach era

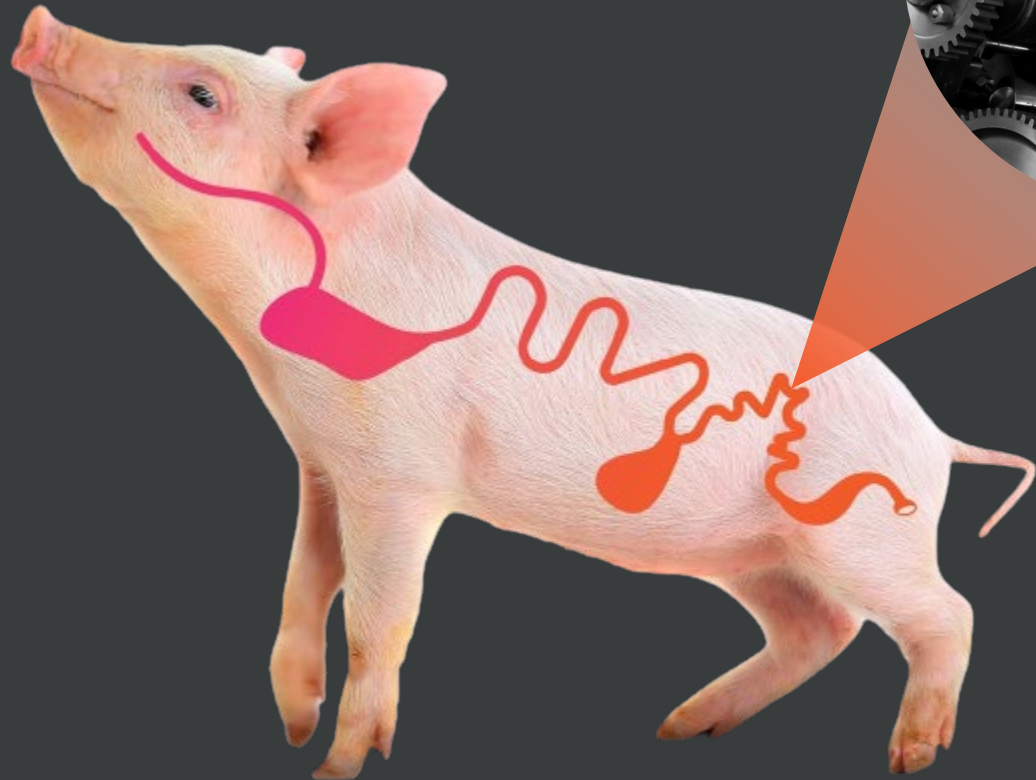




- Ensure a good piglet's microbiota colonization of the piglets;
- Animal welfare is also a way forward;
- Implementation of a **health program** to reduce the risk of future outbreaks and the antimicrobials and ZnO usage.

**Work with
prevention**

**Farmers,
nutritionists,
veterinarians.**



“ Take care of the **piglets** gut first, and it will take care of everything else.”

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Thank you!



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