Risk of ASFV in Feed

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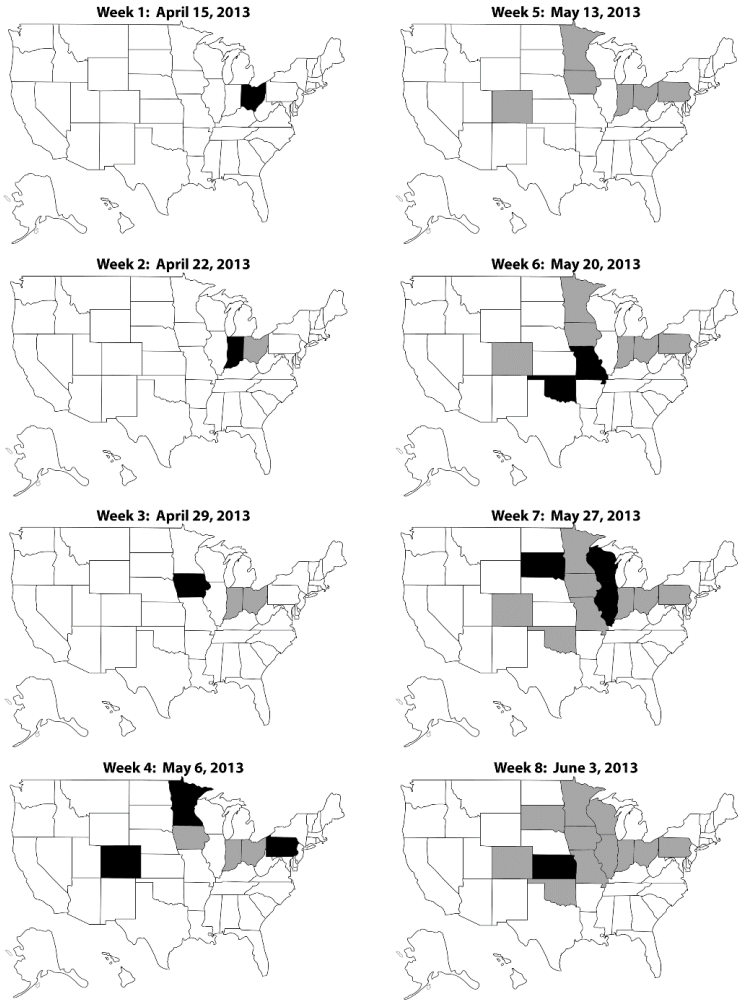
Why Feed?

- Porcine epidemic diarrhea virus
  - Last major transboundary animal disease introduced into U.S.
  - Introduced April 2013
    - Spread rapidly
    - 10% of herd died within 1 year
  - Unveiled **risk of feed** as vehicle for virus introduction and spread



Niederwerder and Hesse, 2018

Feed as a Transboundary Viral Disease Vector

www.approvedindex.co.uk/storage;
www.goodwinecoop.com

What is the **risk of feed** or feed ingredients serving as a route for ASFV **introduction** and **transmission**?

3 Part Approach

1. Determine **survival** in feed and feed ingredients under transboundary model

PLOS | ONE

RESEARCH ARTICLE

Survival of viral pathogens in animal feed ingredients under transboundary shipping models

Citation: Dee SA, Bauermann FV, Niederwerder MC, Singrey A, Clement T, de Lima M, et al. (2018) Survival of viral pathogens in animal feed ingredients under transboundary shipping models. PLoS ONE 13(3): e0194509. https://doi.org/10.1371/journal.pone.0194509

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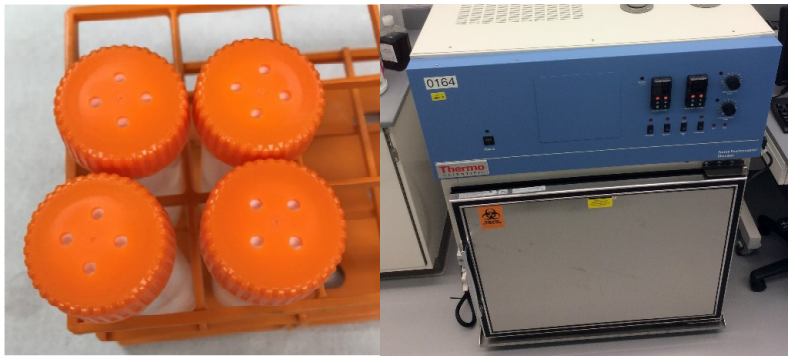
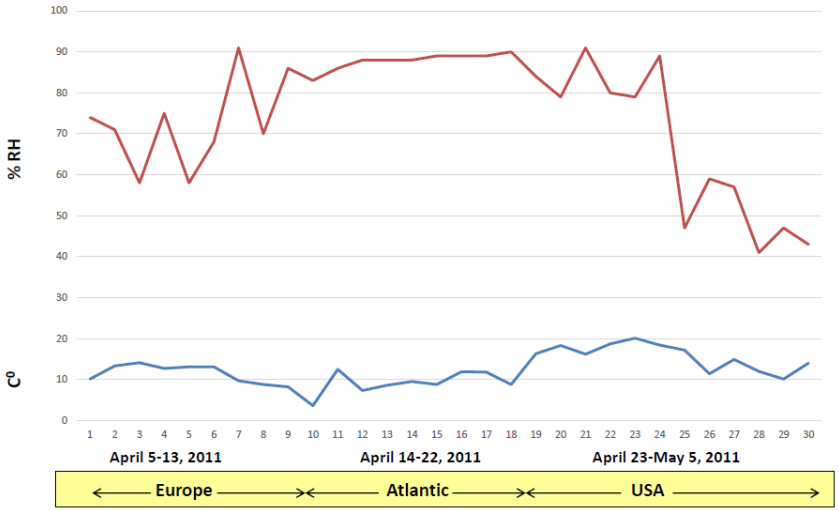
Transoceanic Model

- Feed Ingredients
  - 5 g ingredient + 10^5 $TCID_{50}$ ASFV
- Environmental Chamber
  - Temperature, relative humidity
- Timetable: 30 days
- Diagnostic methods
  - PCR, VI, Bioassay





Dee et al., 2018

ASFV Georgia 07 Survival in Feed

Ingredient	SVA (FMDV)	AS	-1 V)	PRRSV 174	BVDV (CSFV)	VSV	CDV (NiV)	IAV-S
Soybean meal-Conventional	(+)	(	)	(+)	(-)	(-)	(-)	(-)
Soybean meal-Organic	(-)	(		(-)	(-)	(-)	(-)	(-)
Soy oil cake	(+)	(	)	(-)	(-)	(-)	(-)	(-)
DDGS	(+)	(		(+)	(-)	(-)	(-)	(-)
Lysine	(+)	(		(-)	(-)	(-)	(-)	(-)
Choline	(+)	(		(-)	(-)	(-)	(-)	(-)
Vitamin D	(+)	(		(-)	(-)	(-)	(-)	(-)
Moist cat food	(+)	(		(-)	(-)	(-)	(-)	(-)
Moist dog food	(+)	(		(-)	(-)	(-)	(-)	(-)
Dry dog food	(+)	(		(-)	(-)	(-)	(-)	(-)
Pork sausage casings	(+)	(		(-)	(-)	(-)	(-)	(-)
Complete feed (+ control)	(+)	(		(-)	(-)	(-)	(-)	(-)
Complete feed (- control)	(-)	(		(-)	(-)	(-)	(-)	(-)
Stock virus control	(-)	(		(-)	(-)	(-)	(-)	(-)

Ingredient	ASFV
Soybean meal-Conventional	(+)
Soybean meal-Organic	(+)
Soy oil cake	(+)
DDGS	(-)
Lysine	(-)
Choline	(+)
Vitamin D	(-)
Moist cat food	(+)
Moist dog food	(+)
Dry dog food	(+)
Pork sausage casings	(+)
Complete feed (+ control)	(+)
Complete feed (- control)	(-)
Stock virus control	(+)

Promoted virus survival

No detectable virus

Dee et al., 2018

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3 Part Approach

1. Determine **survival** in feed and feed ingredients under transboundary model
2. Investigate **oral dose** and transmission in feed through natural feeding behavior

EMERGING INFECTIOUS DISEASES®

CDC > EID journal > Volume 25 > Ahead of Print / In Press

Volume 25, Number 5—May 2019

Research

Infectious Dose of African Swine Fever Virus When Consumed Naturally in Liquid or Feed

Megan C. Niederwerder, Ana M.M. Stoian, Raymond R.R. Rowland, Steve S. Dritz, Vlad Petrovan, Laura A. Constance, Jordan T. Gebhardt, Matthew Olcha, Cassandra K. Jones, Jason C. Woodworth, Ying Fang, Jia Liang, and Trevor J. Hefley

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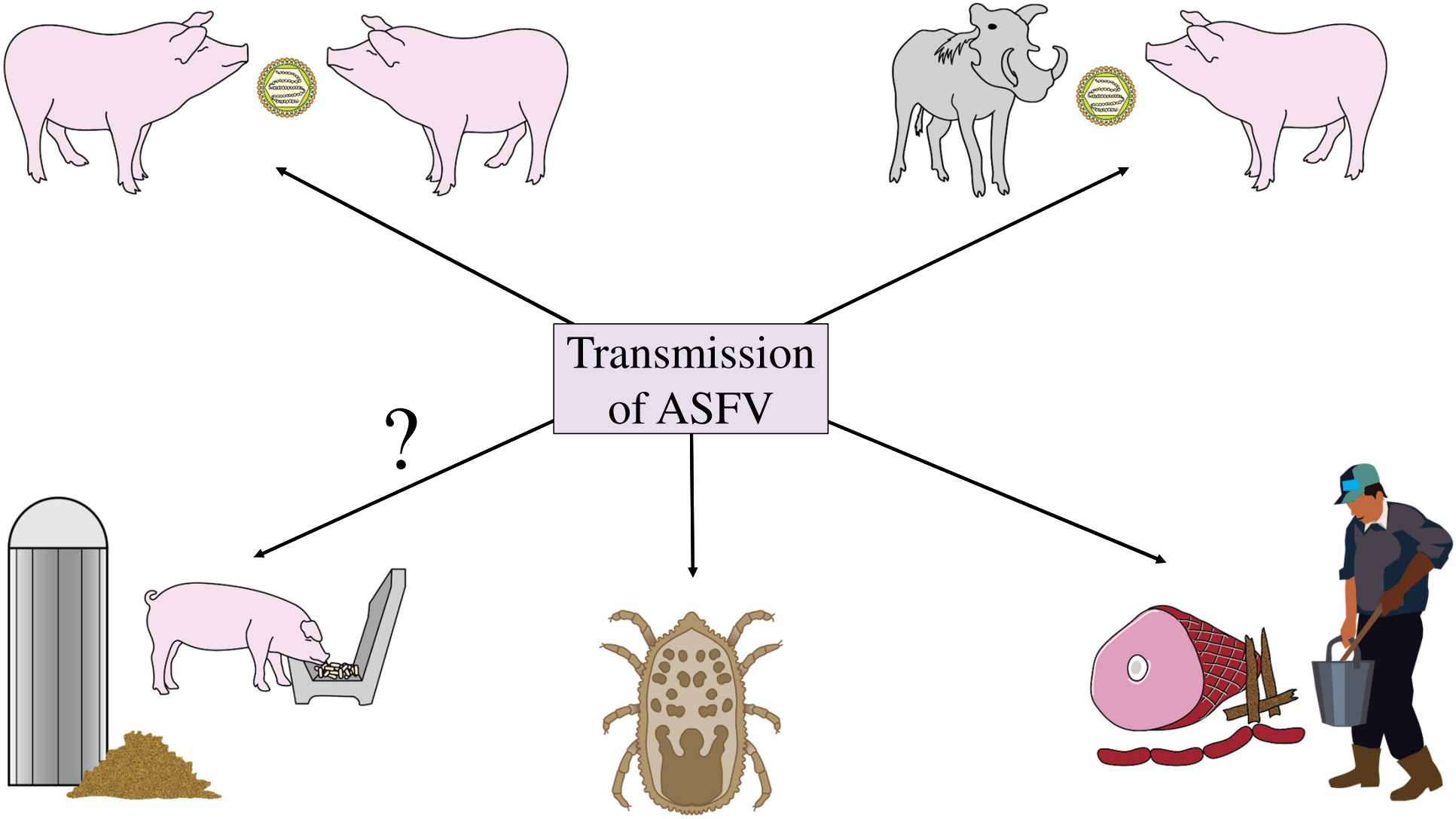
DOI: 10.3201/eid2505.181495


Transmission of ASFV
?

Determine the **infectious dose** and the **risk of infection** for ASFV Georgia 2007 via natural drinking and feeding behavior

Niederwerder et al., 2019. *Emerging Infectious Diseases.*

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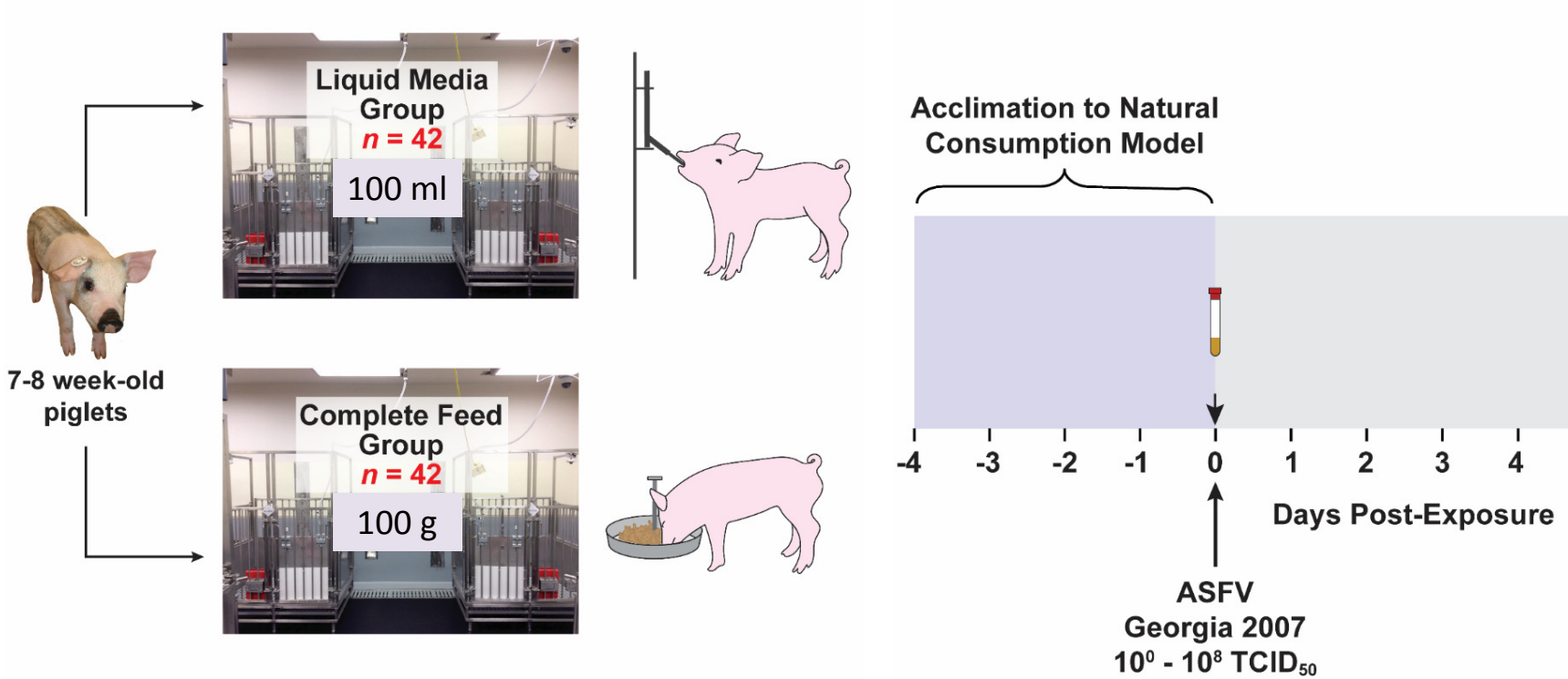
Experimental Design



Niederwerder et al., 2019. *Emerging Infectious Diseases.*

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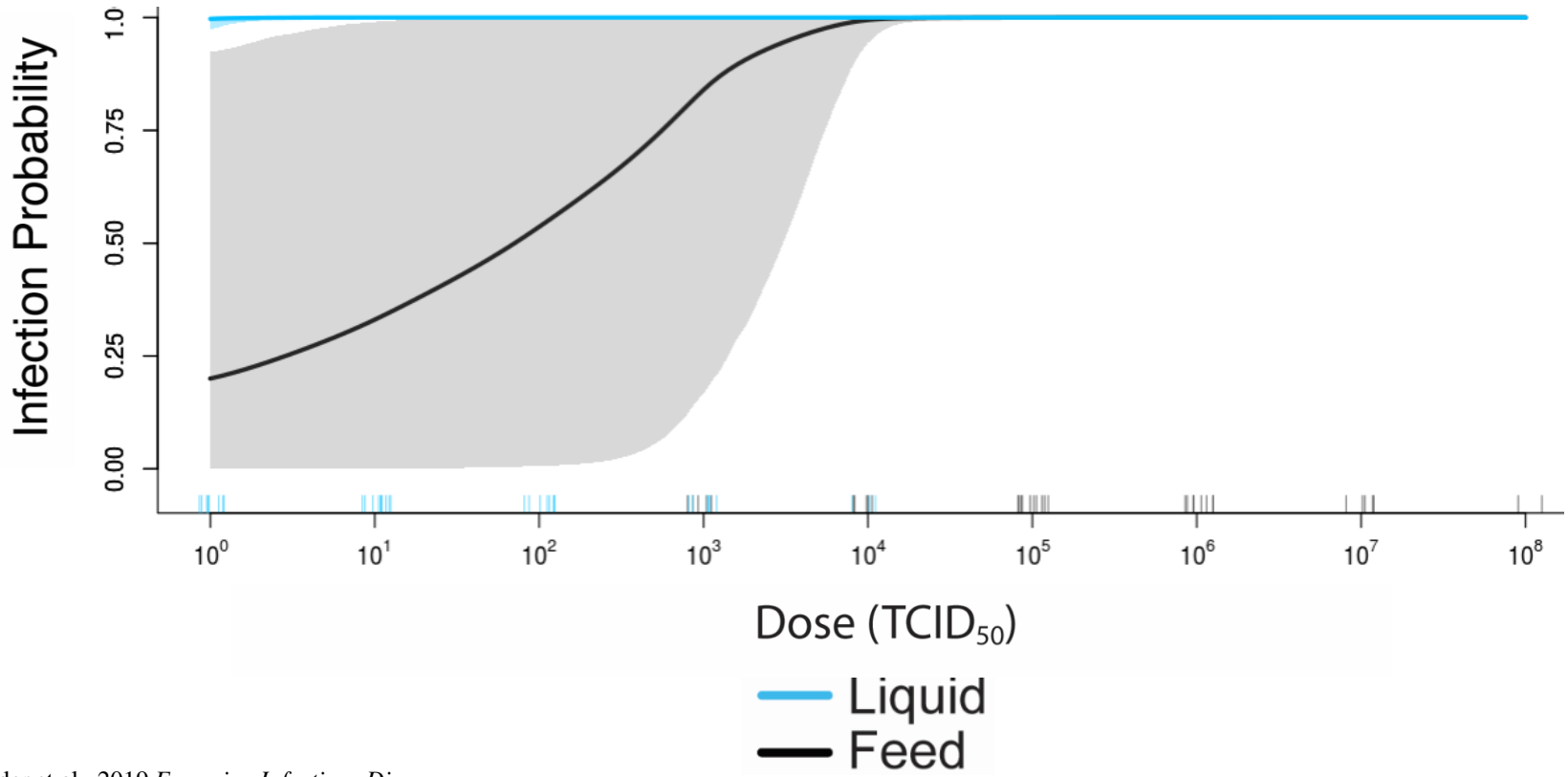
ASFV Oral Exposure

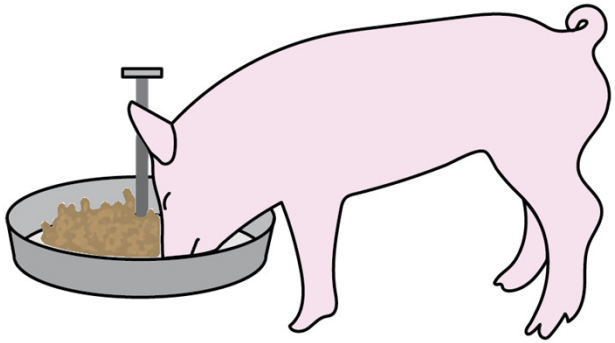
n = 30



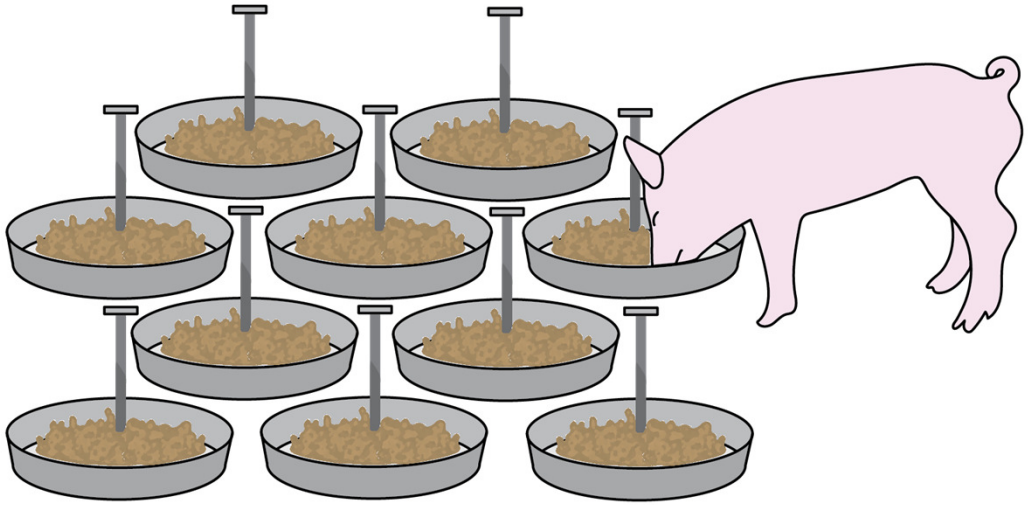
Niederwerder et al., 2019 *Emerging Infectious Diseases.*

Infection probability for repeated ASFV exposures

10^4 $TCID_{50}$ has **25% probability at 1 exposure**



Probability close to **100% at 10 exposures**



Nursery (4 exposures/d) vs Finisher (40 exposures/d)

Niederwerder et al., 2019 *Emerging Infectious Diseases.*

3 Part Approach

1. Determine **survival** in feed and feed ingredients under transboundary model
2. Investigate **oral dose** and transmission in feed through natural feeding behavior
3. Assess tools for **mitigating** risk of transmission in feed and feed ingredients

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Necessity ☑ **Source** ☑ **Risk** ☑

Mitigation

Holding Time
Transport + Storage
ASFV Half-life

Heat Treatment
Time + Temperature
Inactivation Curves

Antiviral Chemicals
MCFA, Organic
Acids, Formaldehyde

Concept of Feed Biosecurity

- Feed and Ingredient Traceability
- Feed Mill Pest Control
- Feed Ingredient Processing
- Feed Ingredient Country of Origin
- Employee Training on Feed Safety
- Virus Survival in Feed Ingredient
- Supplier Approval Program
- Movement of People, Vehicles and Ingredients

Acknowledgements

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