African Swine Fever Virus – Risks for Entry

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African Swine Fever Virus

- The Good
  - Humans cannot contract disease by consuming pork
  - Not transmissible to other non-swine species
- The Bad
  - Can be transmitted from wild boar or ticks to domestic pigs
  - High case fatality
    - Initial infection: low mortality (1-2 mortalities, many ASFV-exposed animals test negative), symptoms similar to *Salmonella*
    - Later infection: highly contagious, 90% mortality
- The Ugly
  - No available vaccine or treatment
  - Survives in fomites for extensive periods
  - Virus is spreading faster than the speed of research

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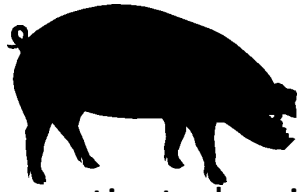
Methods of Transmitting Disease

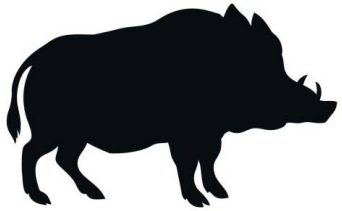
Reservoir

Habitat where agent lives, grows, multiplies



Domesticated swine

Wart hog

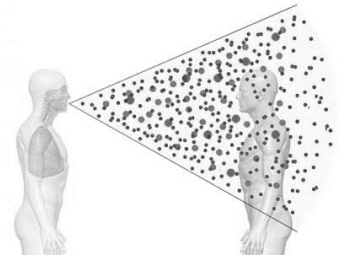


Wild boar

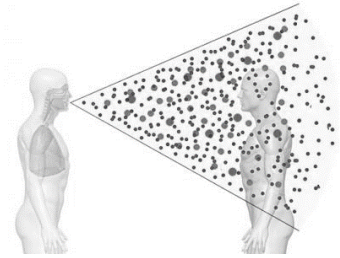
Transmission

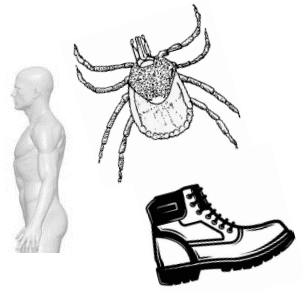
Method of transport from reservoir to susceptible host

Direct



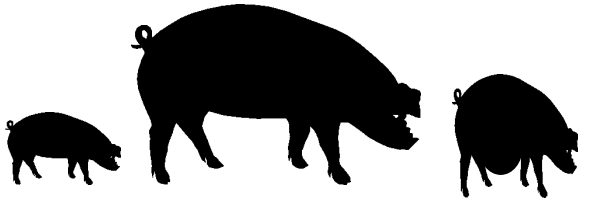
Indirect

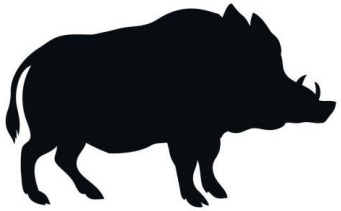




Host

Individual susceptible to the specific agent

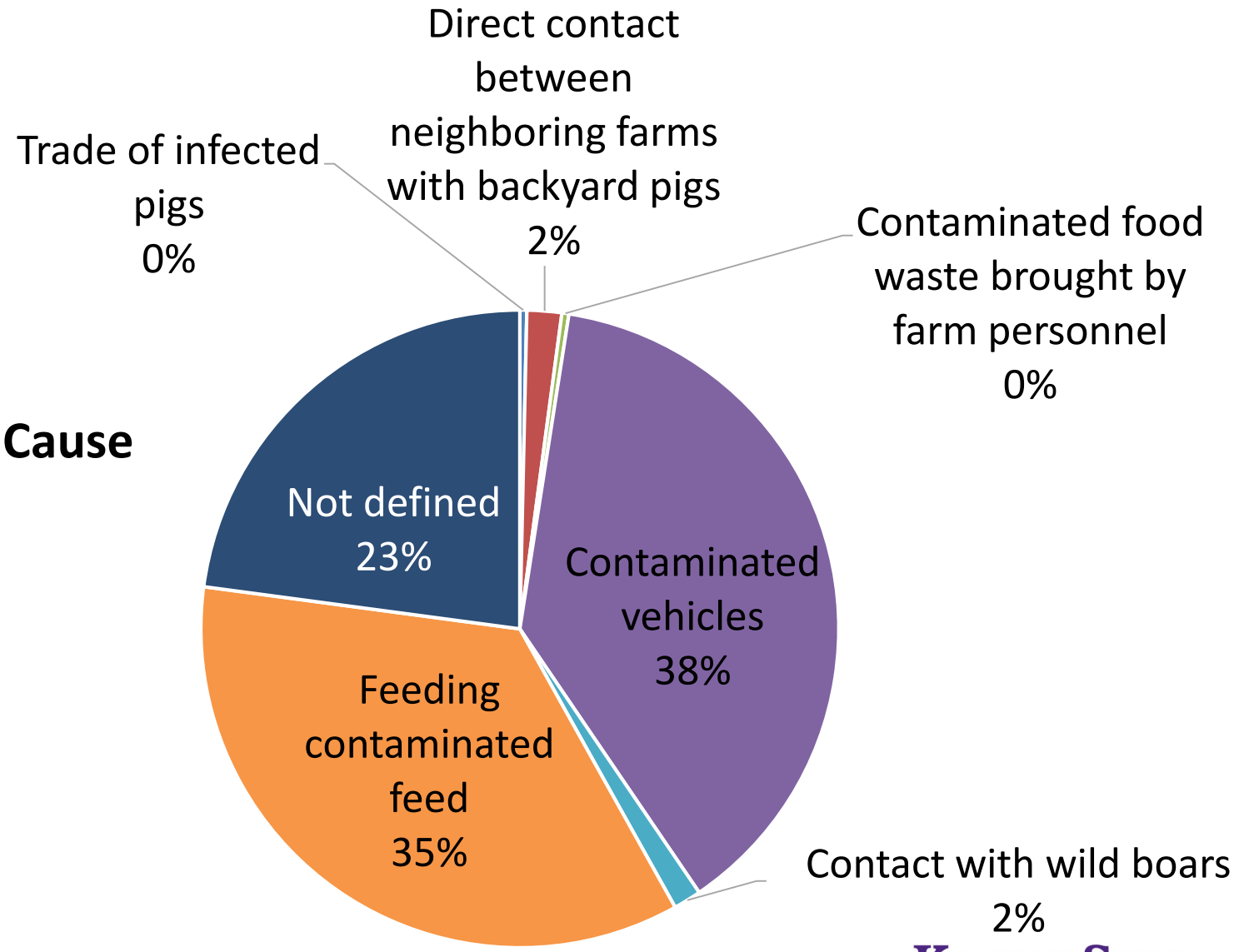




How Has ASFV Entered Naïve Populations?

Russia Epidemiological Root Cause (284 outbreaks)

- **As reported by Belyanin, 2013**



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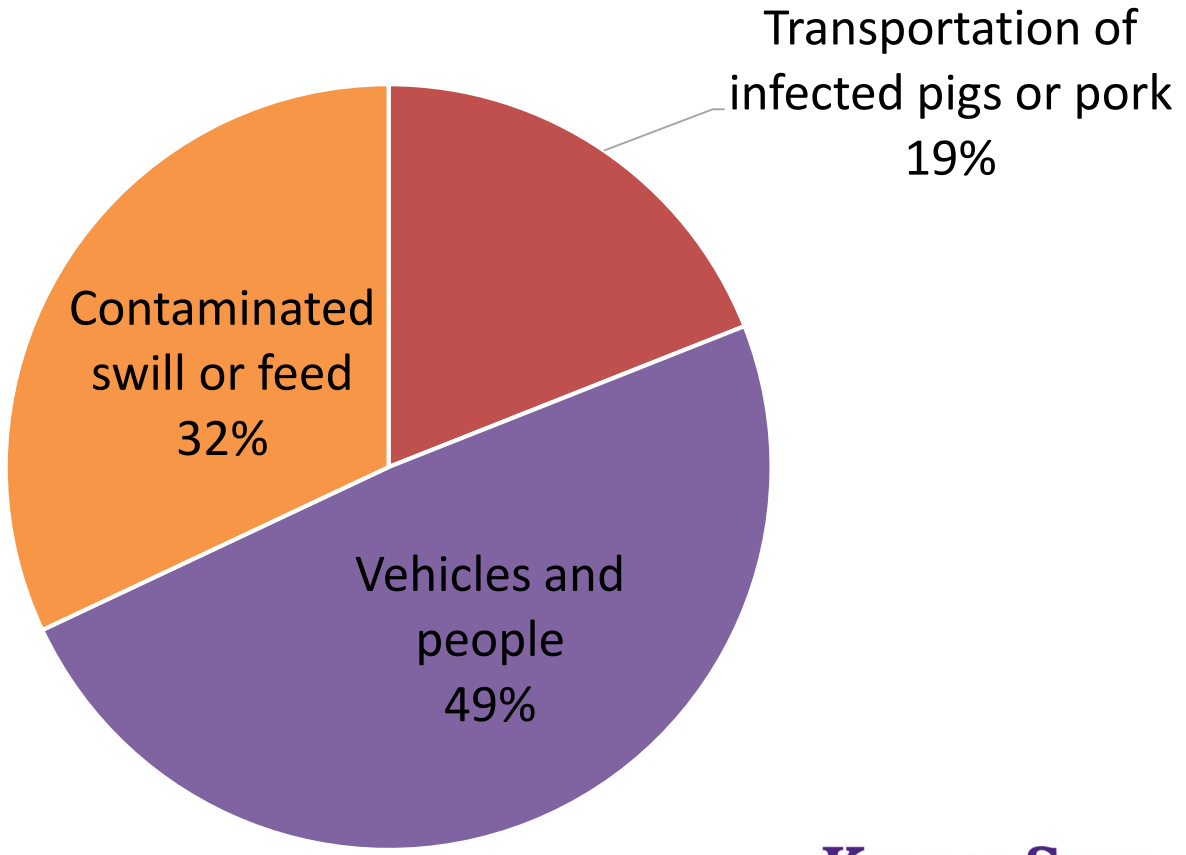
How Has ASFV Entered Naïve Populations?

China Epidemiological Root Cause

(68 outbreaks)

- **As reported by Ministry of Agriculture and Rural Affairs of the People's Republic of China**



How Has ASFV Entered Naïve Populations?

- USDA APHIS Qualitative assessment of the likelihood of African swine fever virus entry to the United States: Entry Assessment

TABLE 1. SUMMARY OF EVALUATED LIKELIHOOD RATINGS BY PATHWAY

Pathway	Legal	Illegal
Live Pigs	Negligible, with low uncertainty	Negligible to low, with moderate uncertainty
Semen	Negligible, with low uncertainty	Low, with moderate uncertainty
Swine products and by-products	Negligible to low, with moderate uncertainty	High, with low uncertainty
Wildlife: Meat and Trophies	<Not reviewed>	Low to moderate, with high uncertainty
Feed (animal origin)	Low to moderate, with high uncertainty	Negligible to low, with high uncertainty
Feed (plant origin)	Negligible to moderate, with high uncertainty	Low, with high uncertainty
Feed (supplements)	Negligible to low, with high uncertainty	<No data to evaluate>
Fomites	<Not reviewed>	Negligible to moderate, with high uncertainty
Regulated Garbage	Low, with moderate uncertainty	<Not applicable>

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Questions Regarding Safety of Feed

1. Is it likely to get infected?
2. Can it survive?
3. Is it infectious?
4. How can it be prevented?
5. How can it be mitigated?

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1. Is it likely to get infected?

- What ingredients are at risk for getting infected with the pathogen of concern?
  - Geographical considerations
    - Countries/regions with active disease outbreaks
    - Location of pigs with disease relative to location of ingredient production
  - Agricultural practices
  - Packaging
    - Single use bags or totes vs. re-used totes or bulk trailers

1. Is it likely to get infected?

- What do we know about the contamination risk of ingredients from ASFV-endemic countries?
  - USDA APHIS Literature Review: Non-animal Origin Feed Ingredients and the Transmission of Viral Pathogens of Swine (2019)
    - "The current body of scientific knowledge has yet to provide conclusive evidence for the source(s) of contamination of non-animal origin feed ingredients with swine viruses and the epidemiology of virus transmission to swine under field conditions. If the primary concern of the swine industry and associated stakeholders lies in the importation of contaminated feed and feed ingredients, then additional research and investigative studies of how ingredients are sourced, processed, and transported prior to importation into the United States are needed. However, the lack of feed and feed ingredient diagnostic assays capable of detecting virus in large volumes of material limits our ability to determine if and at what point non-animal origin feed or feed ingredients may become contaminated with viruses and limits our ability to establish critical control points in feed production, distribution, and storage to mitigate risk(s). Until these data are available, it is difficult to evaluate the biosecurity risk posed by non-animal origin feed and feed ingredients."

1. Is it likely to get infected?

- What do we know about the contamination risk of ingredients from ASFV-endemic countries?
  - Gebhardt et al. (2020) *Submitted*
    - Case study from Vietnam
    - ASFV first reported in Vietnam in February 2019
    - Fall 2019: Samples collected at multiple sites within a single integrated swine production system that had cases of ASFV and was located in one of the most pig-dense provinces in Vietnam
    - Production system used Sal CURB in all diets

1. Is it likely to get infected?

- What do we know about the contamination risk of ingredients from ASFV-endemic countries?
  - Gebhardt et al. (2020) *Submitted*
    - 40 feed/ingredient samples collected
      - None contained detectable levels of ASFV via qPCR
    - 724 environmental samples collected from feed manufacture/delivery and analyzed for ASFV
      - 1.1% contained detectable levels of ASFV via qPCR
      - Nearly all were from feed delivery trucks
      - 1 of the 175 feed mill environmental samples positive (floor surface where feed delivery truck drivers wear footwear previously exposed to surfaces outside the feed mill)
    - Conclusion: ASFV-contaminated feed ingredients did not play a significant role in ASFV transmission or entry into new populations *in this case*

2. Can it survive?

- Insufficient data on pathogen × ingredient × environment

Ingredient	FMD	CSF	ASF	PRV	PEDV
Corn					
Soybean meal					
DDGS					
Wheat midds					
Fish meal					
Porcine plasma					
Whey					
Choice white grease					
Monocal P					
Limestone					
Salt					
Vitamin premix (D)					
TM premix					
Choline Cl					
L-Lys					
DL-Met					
L-Thr					
CTC					
Complete Feed					

Survived simulated trans-Pacific or trans-Atlantic shipment

Did not survive

Not tested/no reported data

Cochrane et al., 2016; Dee et al., 2016, 2018; Stoian et al., 2020

3. Is it infectious?

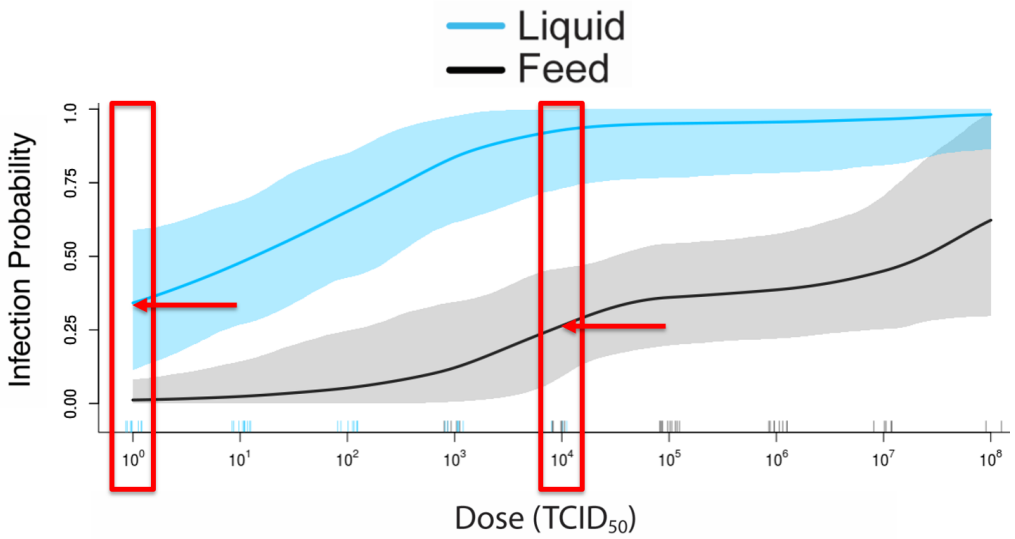
- Contamination of a feed supply likely leads to:
  - Initial dilution of the contaminant (less virus per exposure)
  - Multiple exposures to a single animal over time
  - Multiple animals being exposed simultaneously
- Example:
  - Ingredients are mixed in ~3-ton batches for several minutes to optimize uniformity of nutrients
    - Process likely uniformly mixes in any contaminant, including viruses (depends on fomite consistency)
  - Finished feed is delivered in batches to farms with ~1,200 pigs/barn
    - Nursery pigs typically eat ~20 meals ranging from 100 to 750 g/day
    - 1 feed batch = 24,000+ exposures (meals) in 36 hours

3. Is it infectious?

Summary: One contamination ‘event’ may lead to 1,200 co-housed animals having >20 simultaneous exposures.

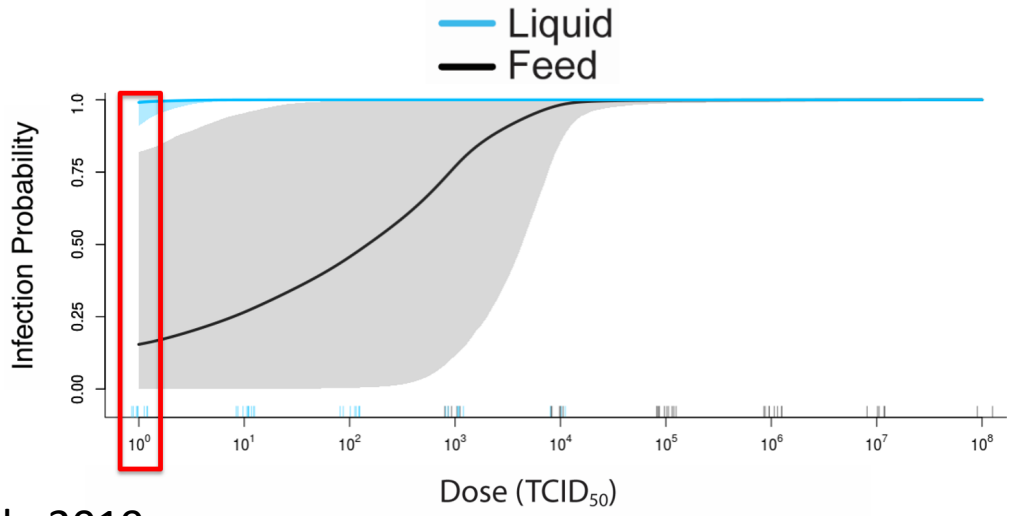
Single Exposure to a Single Animal

(100 g × 1 time)



Multiple Exposures to a Single Animal

(100 g × 20 times)



Research Funded by the National Pork Board; Niederwerder et al., 2019

What Does This Mean?

Feed is just ***one*** *of many potential* vehicles for ASFV transmission – BUT – if ASFV enters the feed supply chain, infectivity is ***almost certain***.

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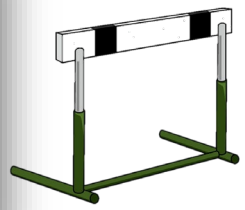
4. How can it be prevented?

5. How can it be mitigated?

Hurdles to Prevent Pathogen Transfer through Feed



Exclude High Risk Ingredients

Extend Biosecurity Practices from Farms to Mills

Active Mitigation

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Summary

- The feed supply chain is not the most likely route of disease entry into the U.S., but it can quickly spread disease.
- What do we need?
  - Continued and additional support
  - Collaboration and dialogue
  - Access to both controlled research and naturally-contaminated environments

www.ksuswine.org/feedsafetyresources

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