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How much do we need to know about ASF to be able to prevent, control and eradicate?

Klaus Depner, Klaas Dietze, Anja Globig, Laura Zani, Thomas C. Mettenleiter

Banff Pork Seminar
January 7-9, 2020

Understanding ASF

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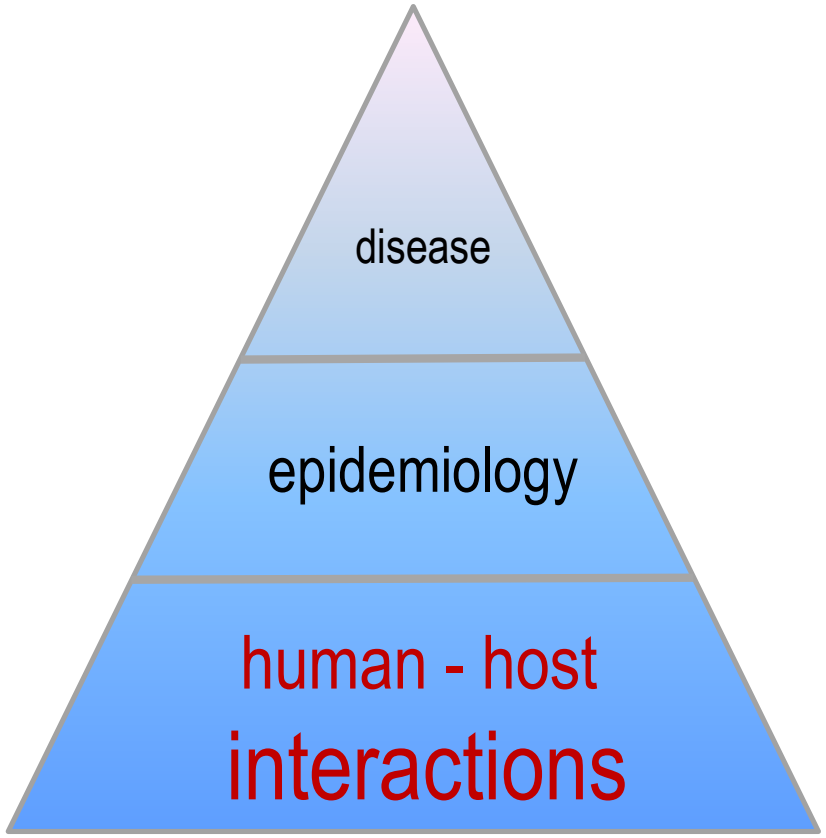

Described by Eustace Montgomery in East Africa (Kenya), 1921

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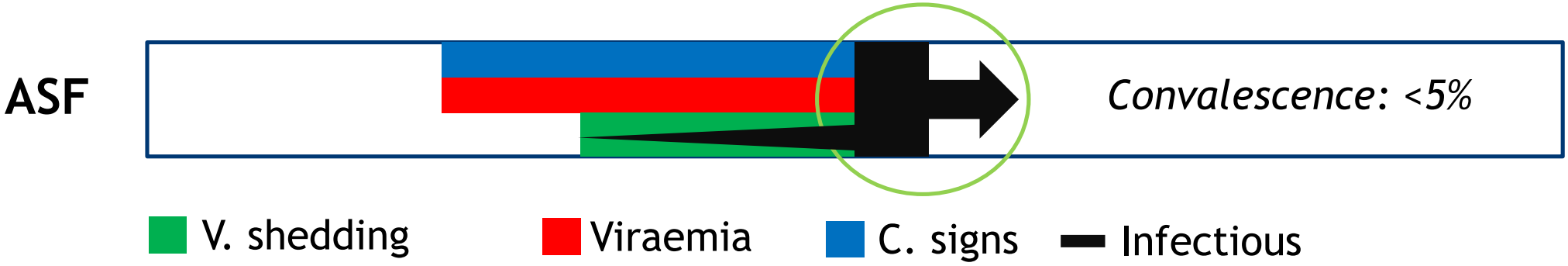
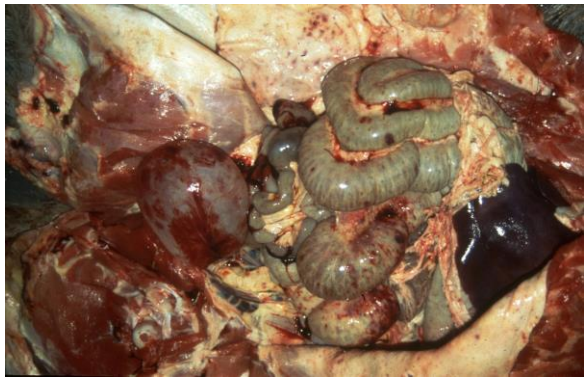
A domestic pig infected with ASFV will in most cases develop a severe haemorrhagic disease ending with death within a couple of days (*Plowright, 1994*)

High case fatality (>90%)





4 cycles

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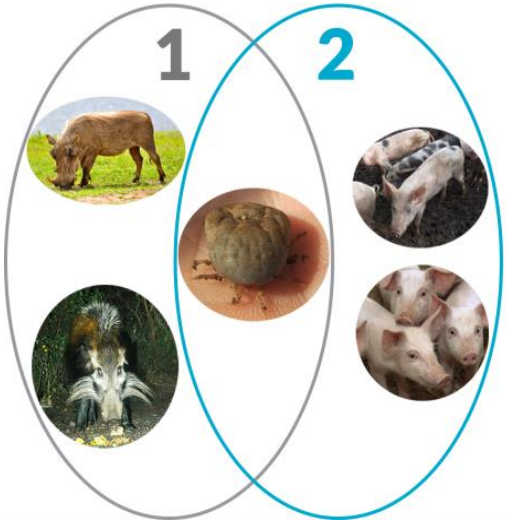
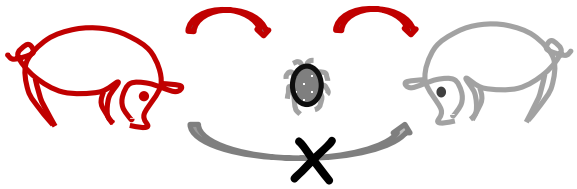
Non-contagious ASF



1. Sylvatic
2. Tick-Pig
3. Domestic
4. Wild Boar

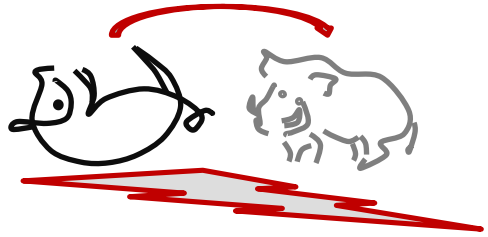
Contagious ASF

parenteral transmission *(tick bite)*



Vector born disease

oral infection



Habitat disease

Chenais et al., 2018

Non-contagious ASF

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- **No clinic**
- Adapted natural host
- No shedding
- Vector born

- **Clinic**
- Non-adapted host
- „*Accidental*“ host
- Vector born

Tick bite: efficient, indirect parenteral transmission

The asymptomatic wild suids and ticks allow a cycle which can be maintained indefinitely in Africa *(Parker et al., 1969)*

The balance between the natural hosts and the ASFV was altered by the introduction of domestic pigs by colonists from Europe into Africa *(Pini and Hurter 1975)*

** Role of bushpigs in the sylvatic cycle unknown*

Chenais et al., 2018

Contagious ASF

- **Clinic**
- Non-adapted host
- „Accidental“ host
- “Poor” shedding

- **Clinic**
- Non-adapted host
- „Accidental“ host
- “Poor” shedding
- Habitat disease

Direct but less efficient transmission, most orally in the absence of ticks,
“***atypical transmission***”

Depends on virus dose, infectious material, animal behaviour, management, contamination of environment,…

Chenais et al., 2018

A short history of ASF

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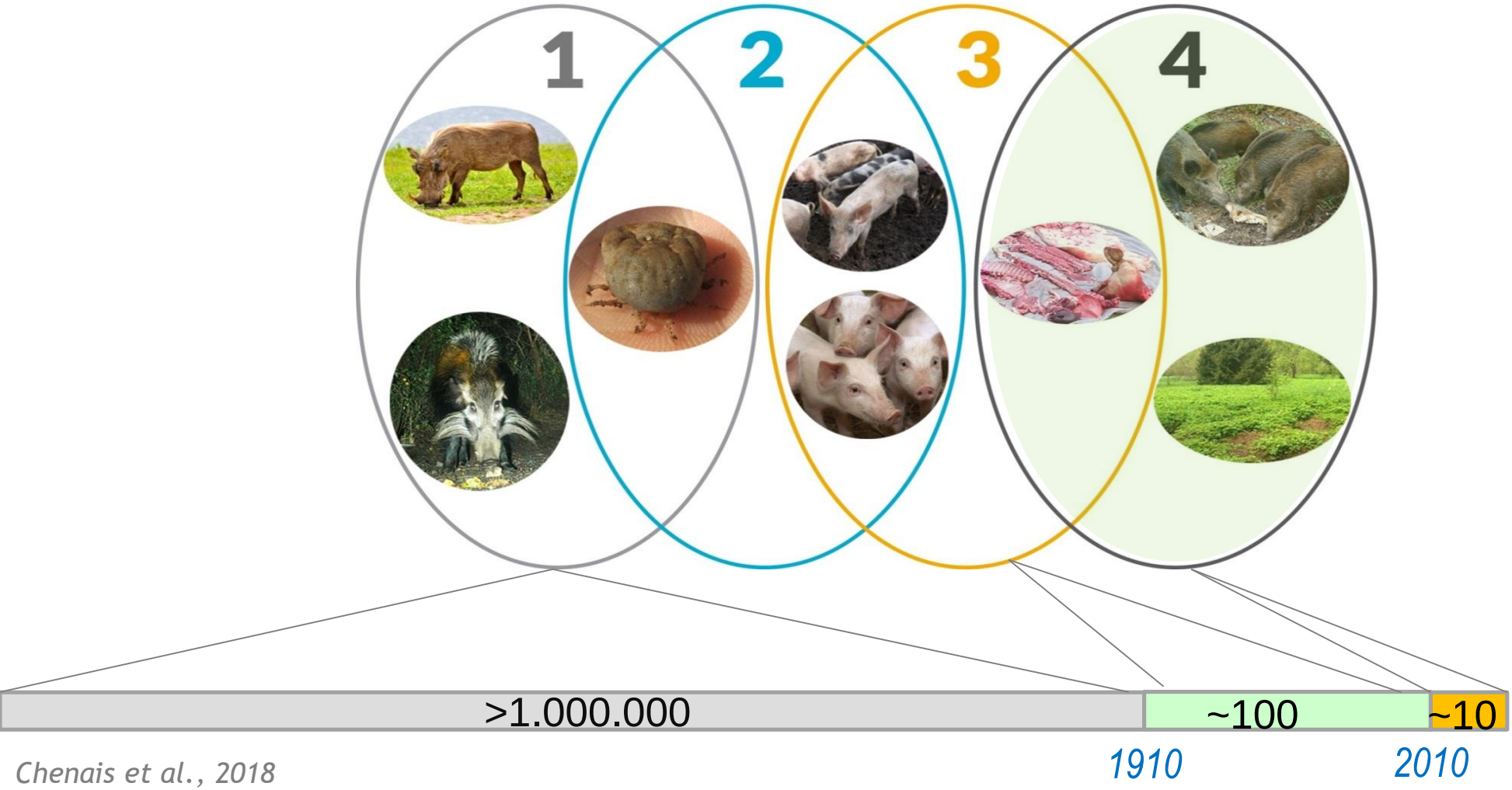


Chenais et al., 2018

Working hypotheses

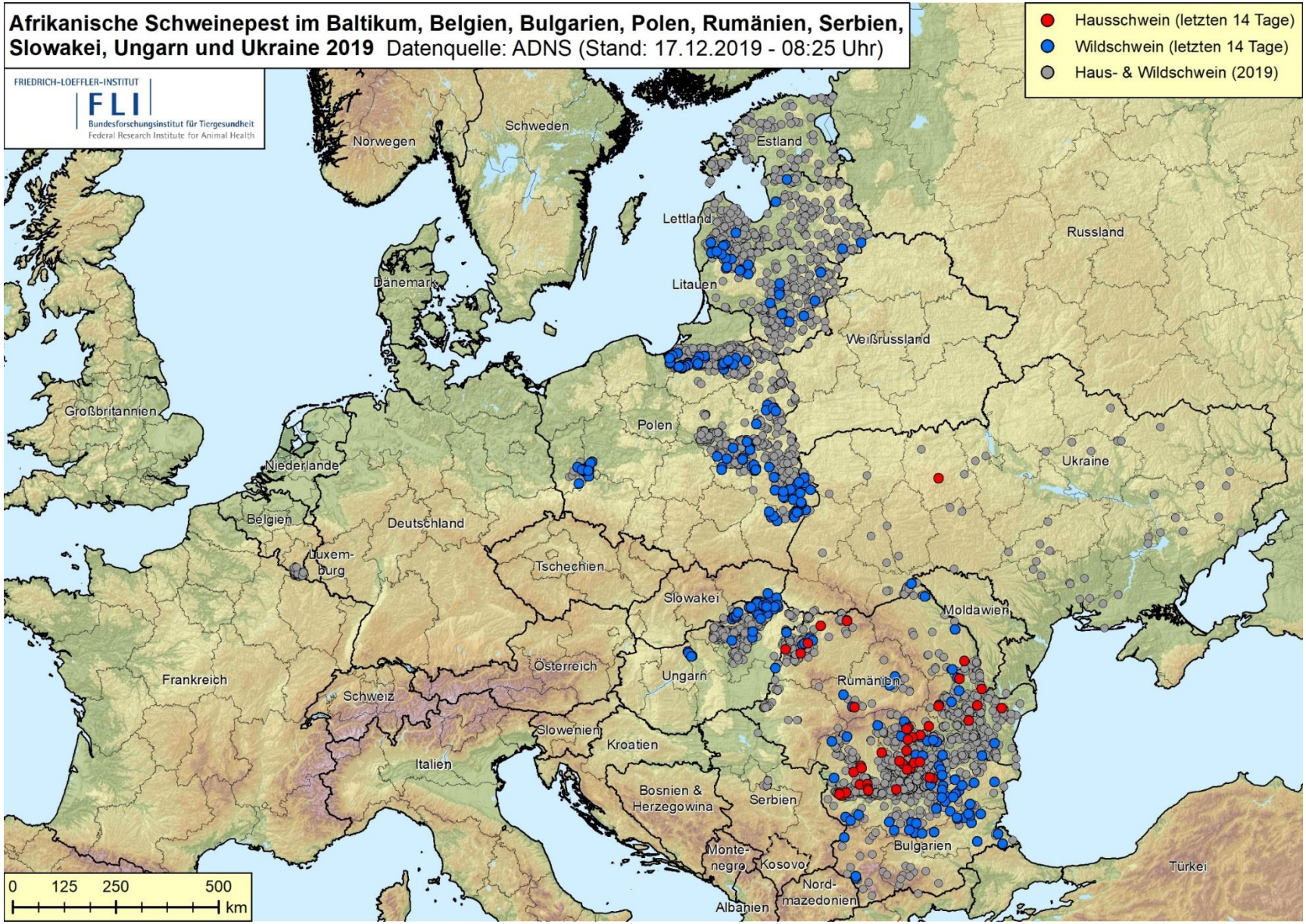
1. **IMPLOSION**: ASF will fade out rapidly due to *high mortality*
2. **EXPLOSION:** ASF will spread rapidly (Rabies like) initiating an epidemic wave

years later…….

both hypotheses proved to be wrong !!!

- NO implosion
- NO explosion

=> Endemic in the region, slow spread


Afrikanische Schweinepest im Baltikum, Belgien, Bulgarien, Polen, Rumänien, Serbien, Slowakei, Ungarn und Ukraine 2019 Datenquelle: ADNS (Stand: 17.12.2019 - 08:25 Uhr)
Hausschwein (letzten 14 Tage)
Wildschwein (letzten 14 Tage)
Haus- & Wildschwein (2019)
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Norwegen
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Lettland
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Litauen
Dänemark
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Großbritannien
Polen
Niederlande
Ukraine
Belgien
Deutschland
Luxem-burg
Tschechien
Slowakei
Moldawien
Frankreich
Österreich
Ungarn
Rumänien
Schweiz
Slowenien
Kroatien
Italien
Bosnien & Herzegowina
Serbien
Monte-negro
Kosovo
Bulgarien
Türkei
Nord-mazedonien
Albanien
0 125 250 500 km

ASF virus is relatively stable

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High tenacity

ASFV survives the process of putrefaction and carcasses may remain infectious for weeks

- frozen meat: indefinitely
- dry meat and fat: almost one year
- blood, salted meat and offal: more than 3 months
- faeces: over one week

Temperature plays an important role in decreasing the survival duration of ASF virus in any material.

Textbooks are misleading…

copy/paste …

"ASF is a highly contagious disease… causing high mortality up to 100%…"

- *Mortality: Dead animals / epidemiological unit*
- *Case fatality (lethality): Dead animals / infected (diseased) animals*

Contagiosity/Contagiousness

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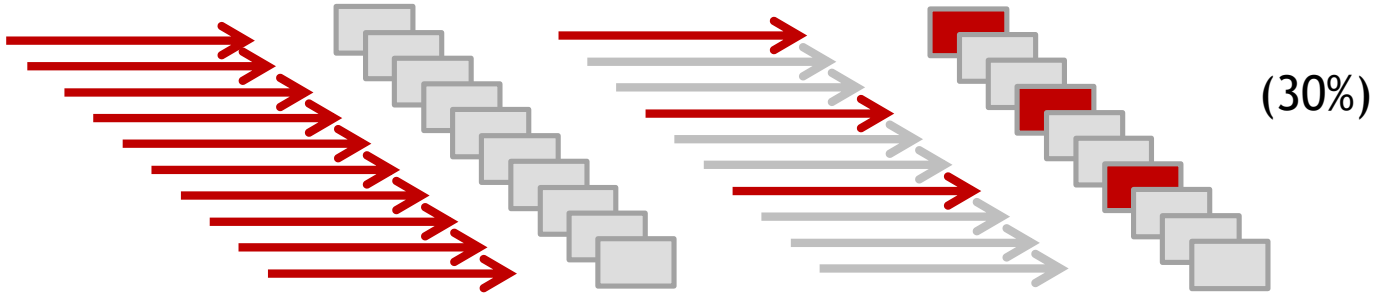
Percentage of animals which get infected after contact with an infectious agent

Probability of infection *after contact with a pathogen*



It is NOT an indicator for disease severity and impact!!!

- ***Low contagious diseases with severe course and high impact***
- ***Highly contagious diseases with mild course and low impact***

ASF - CSF - FMD

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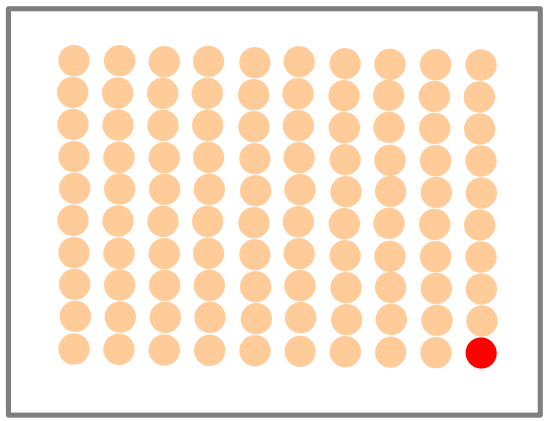
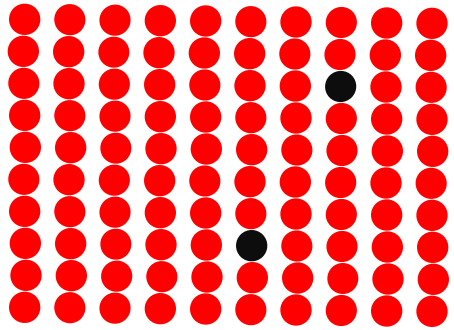




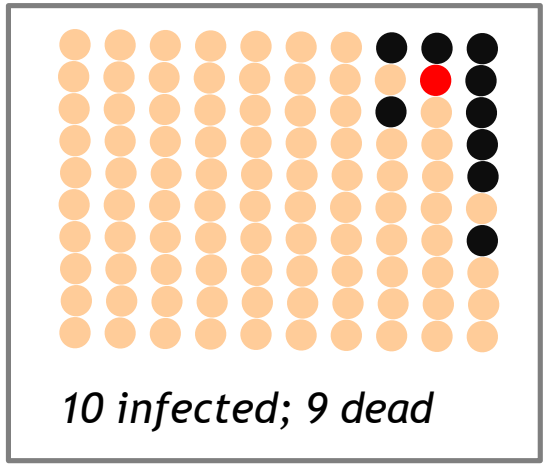
100 infected; 2 dead

FMD

Prevalence: 100%
Mortality: 2%
Lethality: 2%

Contagiosity: +++

● Infected ● dead

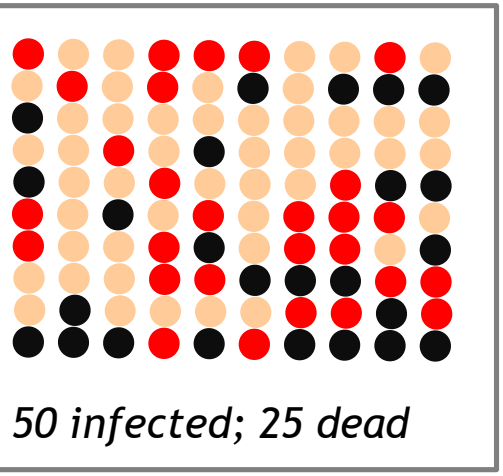


10 infected; 9 dead

ASF

P: 10%
M: 9%
L: 90%

Contagiosity: +



50 infected; 25 dead

CSF

P: 50%
M: 25%
L: 50%

Contagiosity: ++

Probability of infection

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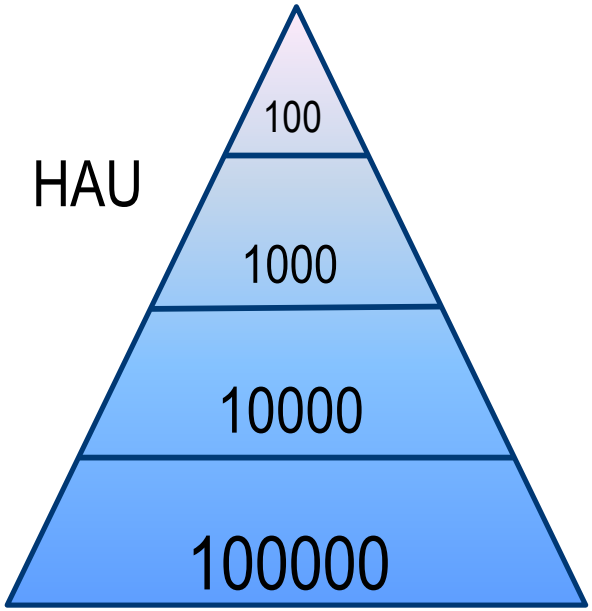
Virus dose & contagiosity



10% (low)

60% (medium)

90% (high)

- *Pietschmann et al. 2015*
- *Gabriel et al. 2011*
- *Petrov et al. 2018*
- *Nurmoja et al. 2017*
- *Zani et al. 2018*

Sulcus ventriculi

Water or Feed

1 vs.10000 $TCID_{50}$

M. Niederwerder et al. 2019

Persistence triangle

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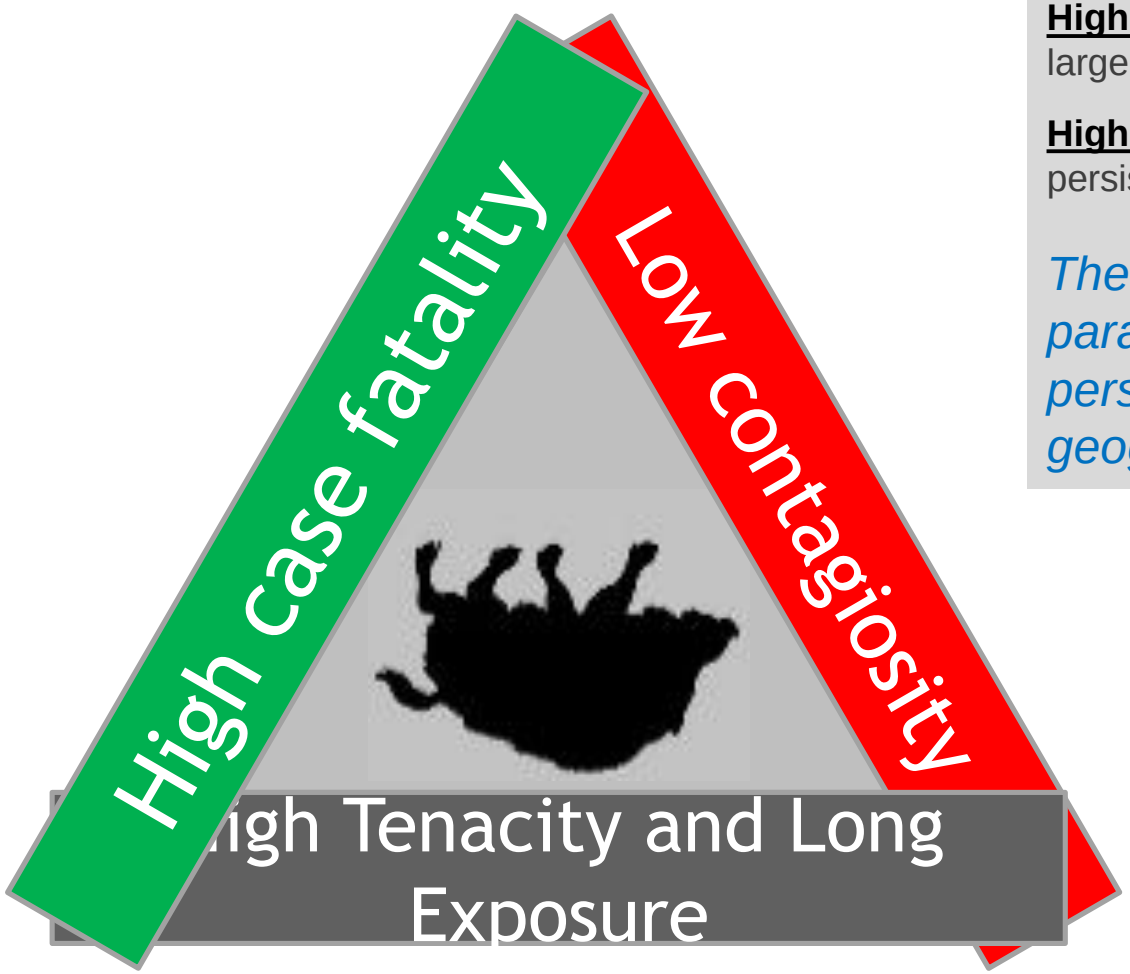


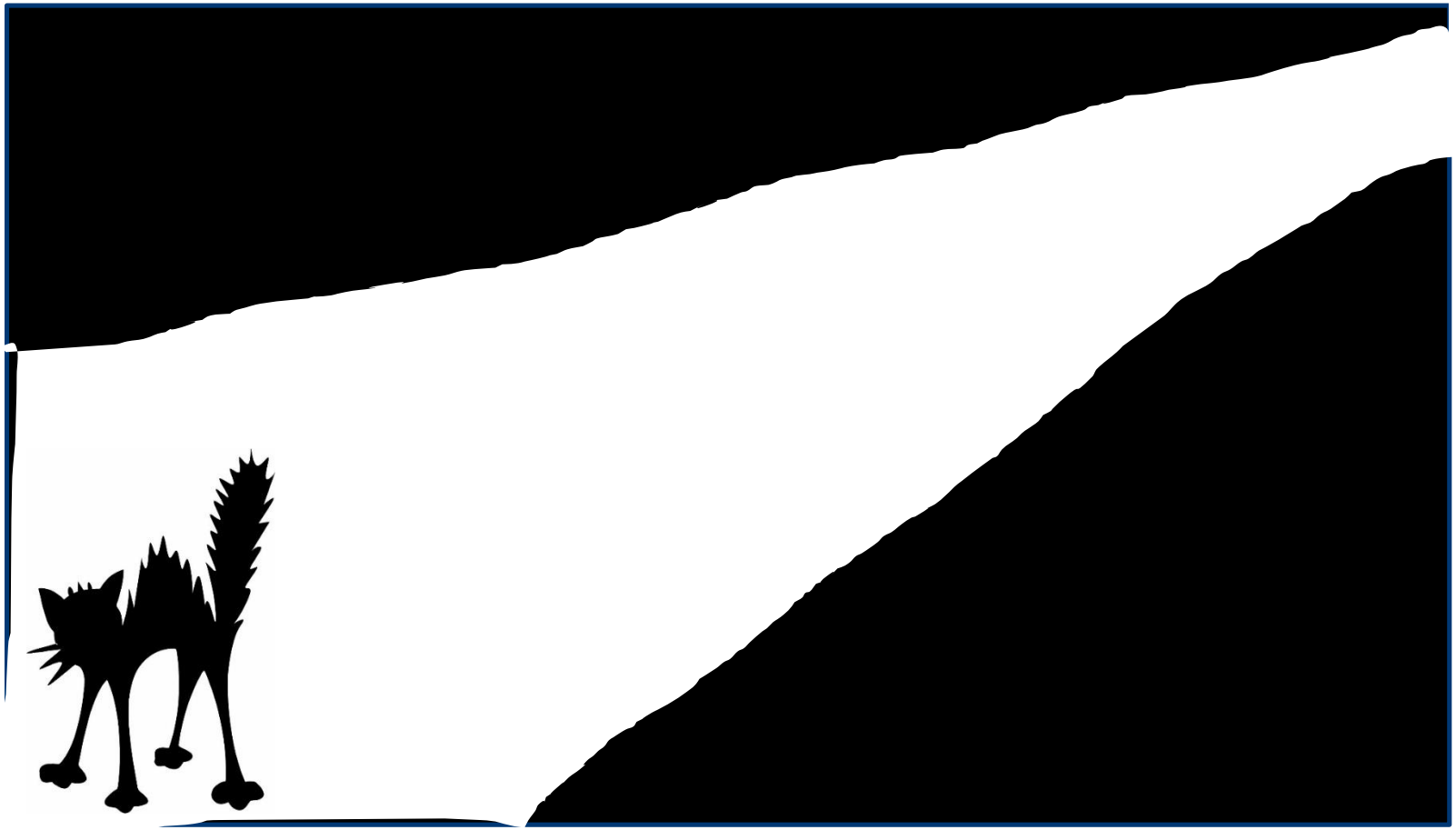
Low contagiosity: prevents fast and complete depletion of the host population

High case fatality: makes the virus largely available in the form of carcasses

High tenacity: ensures long term virus persistence in the environment

The interaction of these three parameters maximize local persistence and limits fast geographical spread

Surveillance



Pig farm in an early stage of ASF

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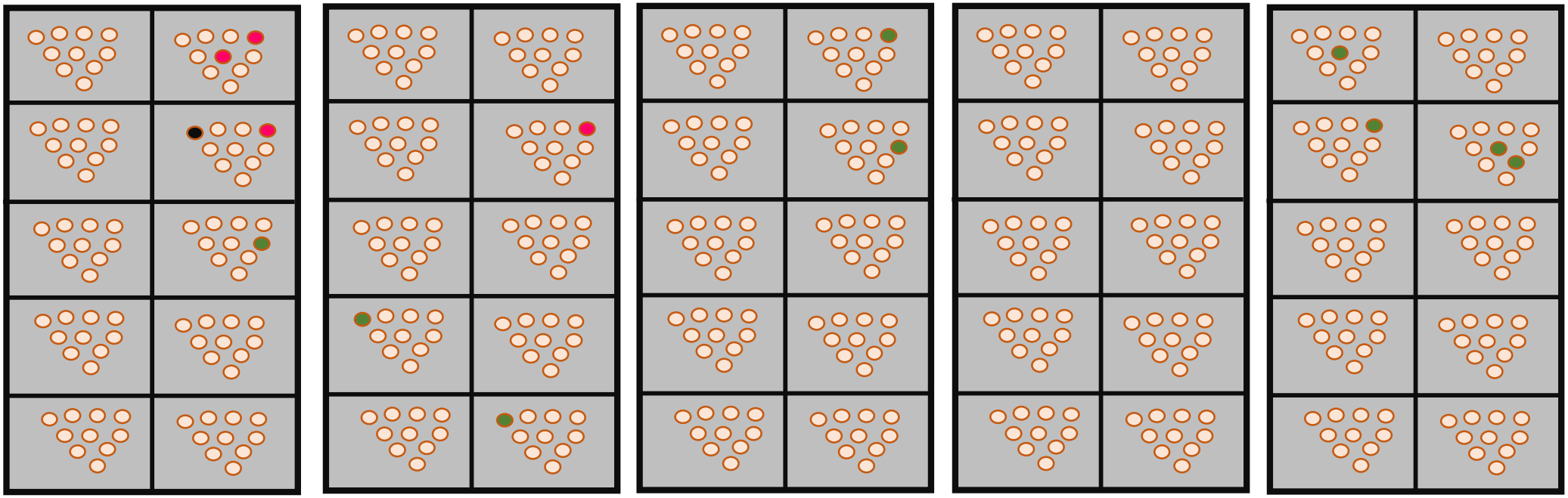
Task: Imagine that you have 50 pig farms in the region your are responsible for. You would like to set up an early detection strategy for ASF.
One farm got infected with ASF. How would you find this farm? The farm has 500 pigs in 5 stables; 2% mortality within 2 weeks. Four pigs are clinically sick due to ASF (high fever), one pig died due to ASF. Nine pigs died due to other reasons during last two weeks.



- Healthy pig
- ASF infected pig (high fever)
- Dead pig (ASF)
- Dead pig (no ASF)

Q: What would be your sampling strategy for early ASF detection?

- *Random sampling (how many animals?)*
- *Targeted sampling (which animals?)*

Q: Which test would you recommend?

- *Antibody test*
- *PCR/Virus test*

Created by: Klaus, Anja and Laura (FLI)

High risk period & farm size

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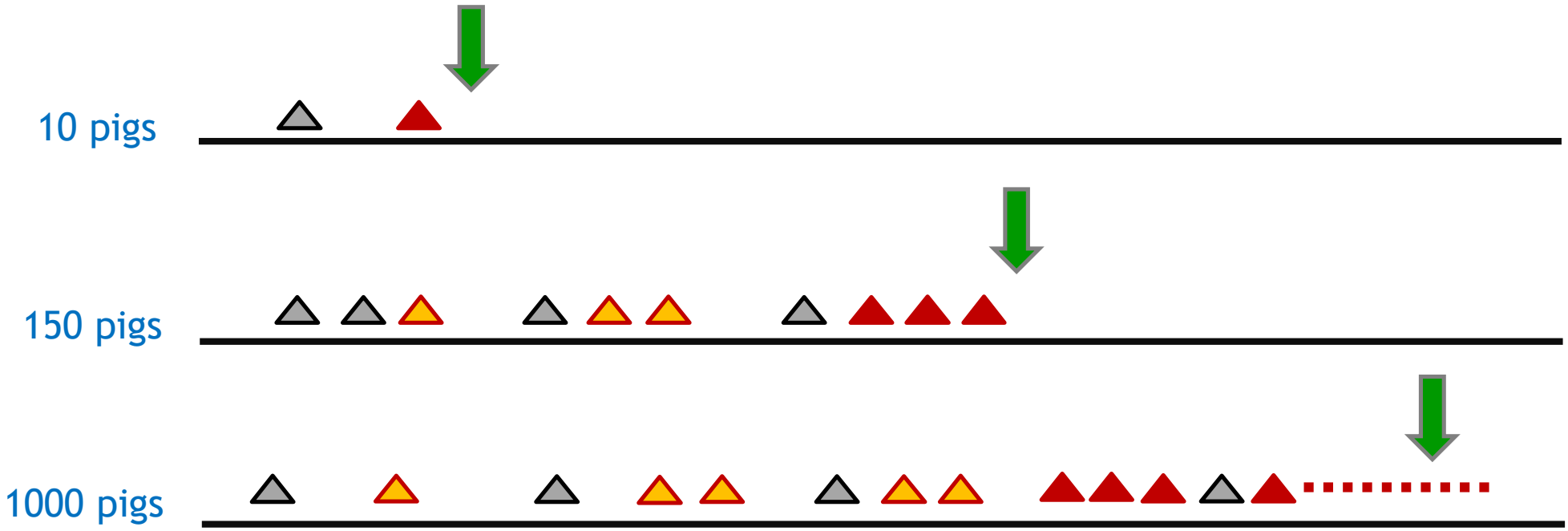
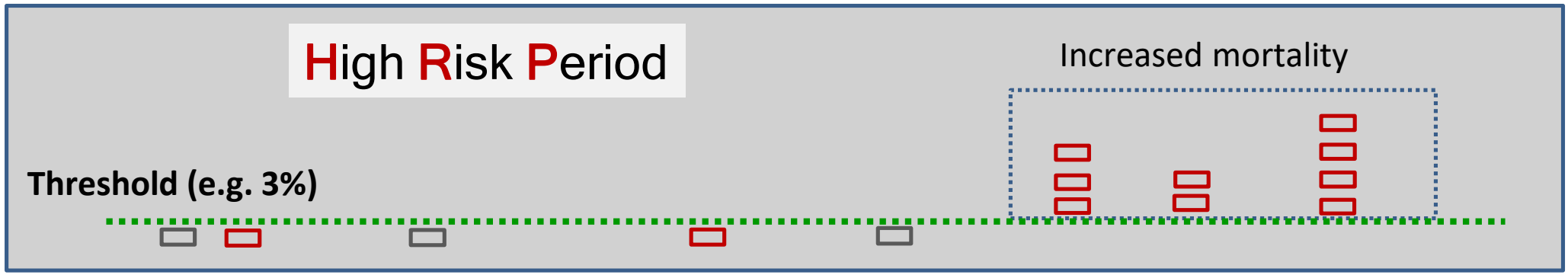




EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR HEALTH AND FOOD SAFETY

Directorate G - Crisis management in food, animals and plants
Unit G3 – Official controls and eradication of diseases in animals

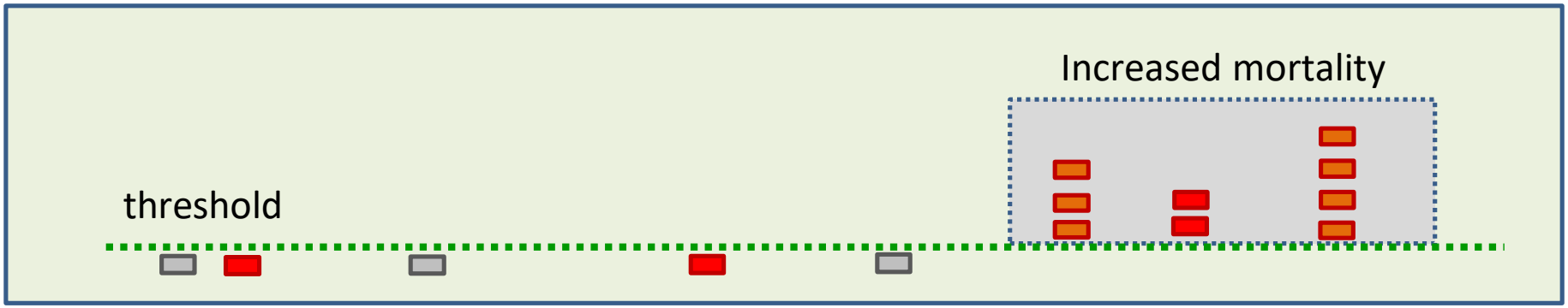
Brussels
SANCO G3/FB (25.11.2019)

2.1.5. Sampling for laboratory investigations will be performed

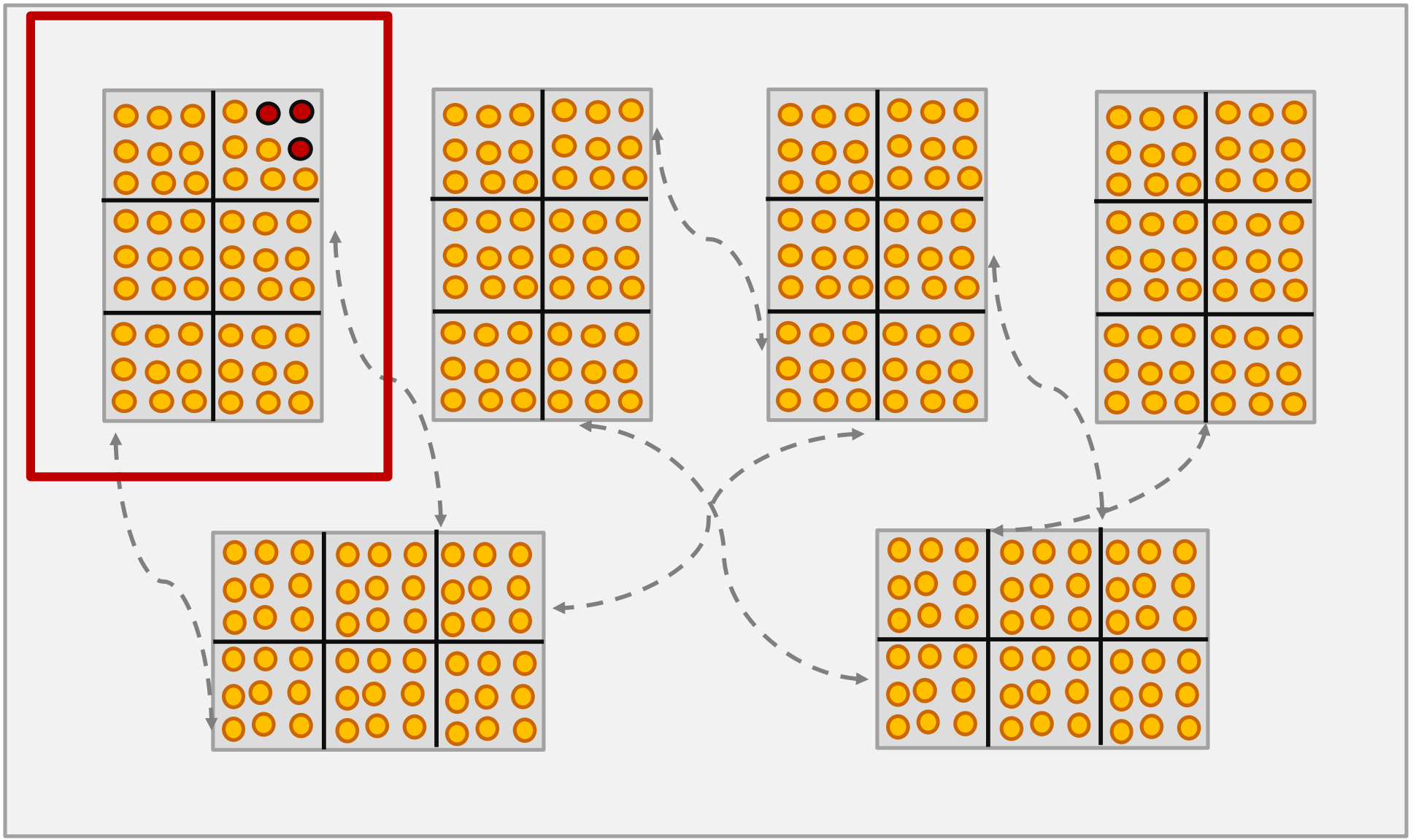
a) In case of clinical signs resembling ASF (e.g. fever or haemorrhagic lesions). If necessary, sampling should be repeated to exclude ASF when specific clinical signs occur.

b) Each week, in the form of virological testing of at least the first two deaths (post weaning pigs or pigs older than 2 months) in each production unit.

c) When ante or post-mortem signs raise suspicion at home slaughtering at least within the area covered by Commission Decision 2014/709/EU.



Dilemma



Passive vs. active surveillance

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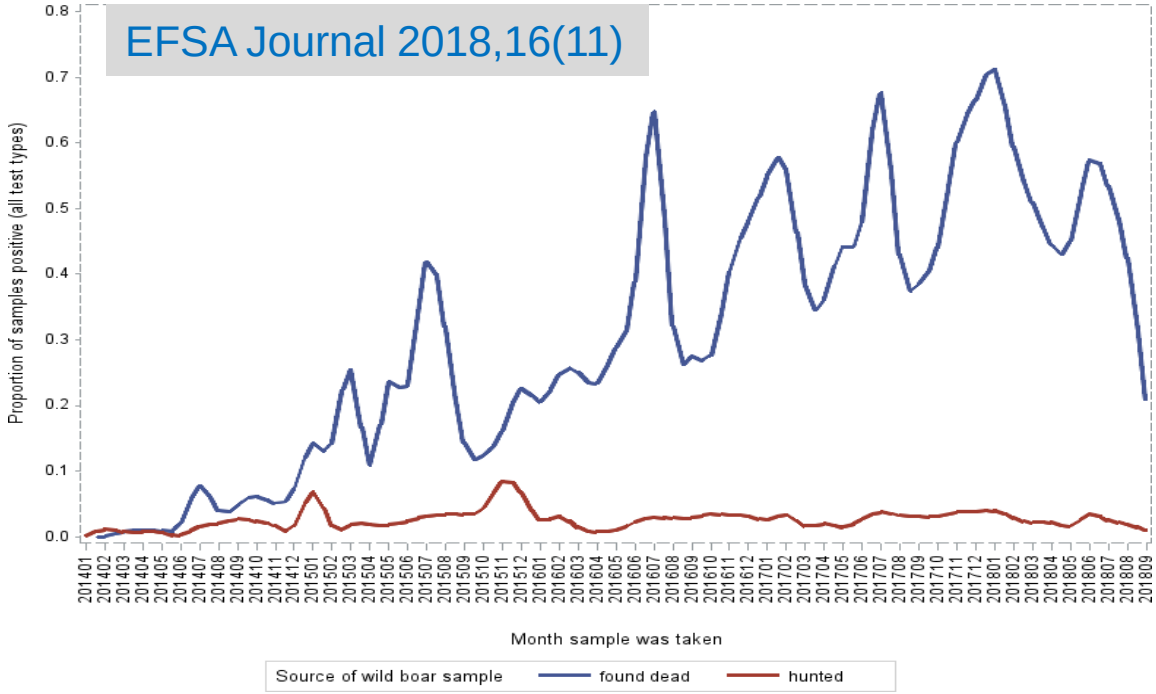
The probability to detect ASF is many times higher in sick or dead animals than in (healthy) randomly sampled animals

(~80 out of 100** cases are detected in wild boar found **dead)



	n	pos.	% pos.
Passive (found dead)	245	177	***72.24***
Active (hunted)	2765	40	***1.45***

Active surveillance in wild boar is particularly cost inefficient as a tool for early detection in free countries/areas, whereas it is useful for understanding the epidemiology in endemic areas

Biosecurity

the most effective control tool

The only potent tool we have...

Along the road and tradition

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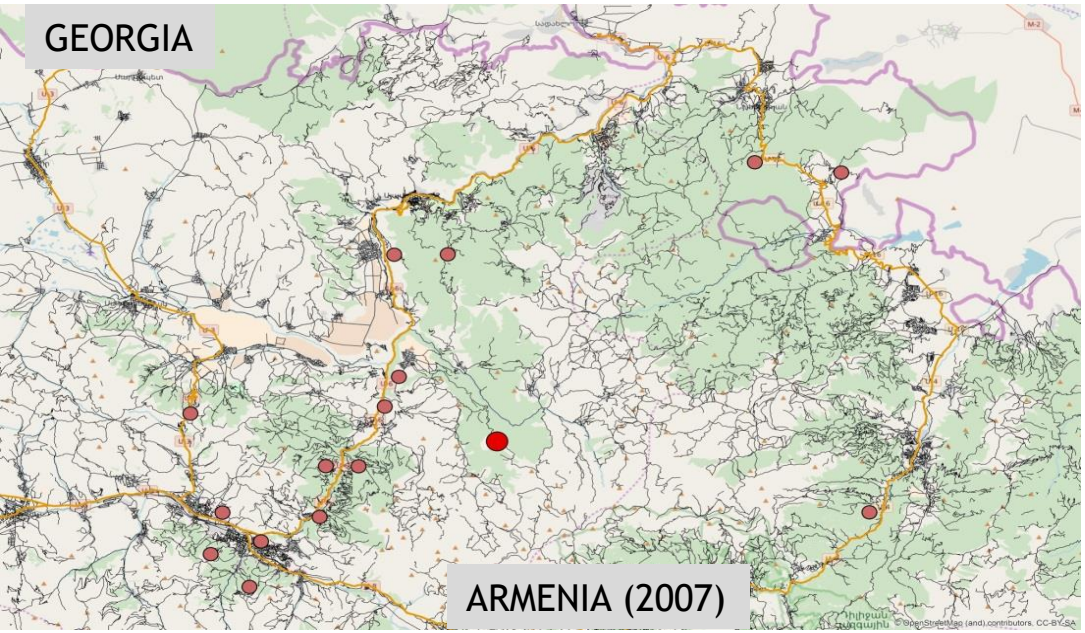
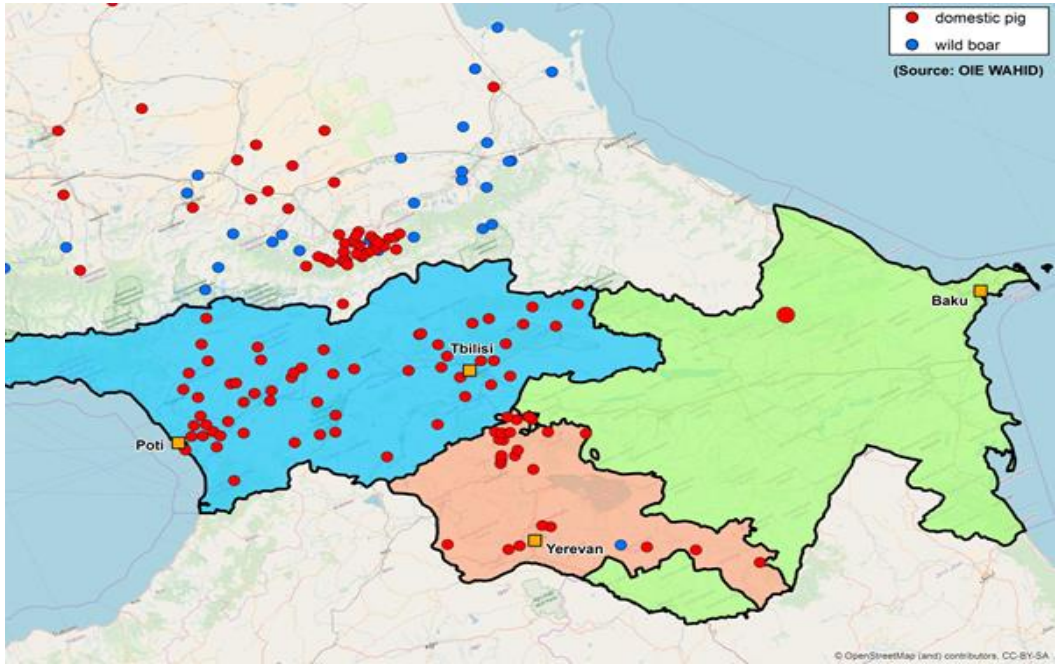


Three basic biosecurity rules

1. No swill feeding
2. No contact with strangers
3. Change boots before entering the stable



Biosecurity

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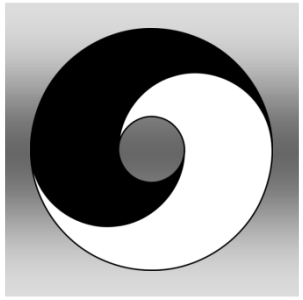
Hardware

Money

Software

(Mindset/Philosophy/Management)



Education

J. Westergaard

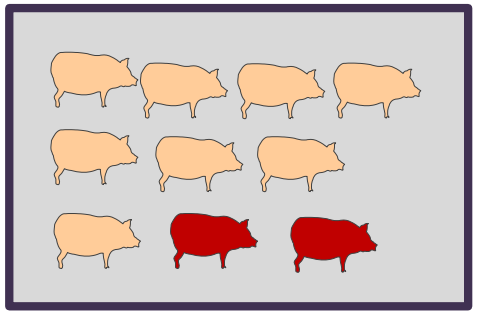
„ … the precautions now being exercised beneficially show that under the conditions at present existing the disease is one ***which can in large measure be avoided“***

E. Montgomery 1921

Key characteristics of ASF:

- low contagiousity, slow spread, few secondary infections
- **site fidelity** (stable disease / habitat disease),

DP: stable disease

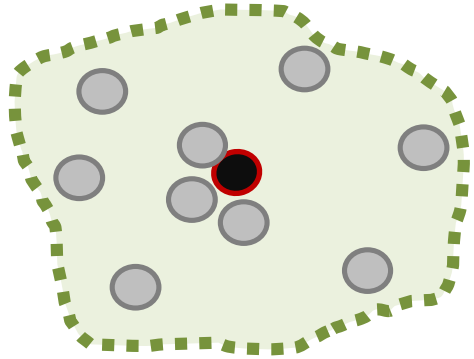


Measures:

1. Standstill
2. Culling
3. C&D

Successful approach!!

WB: habitat disease



Measures:

1. Standstill (no disturbance of WB, no hunting, electrical fence, (feeding)
2. (Trapping)
3. Disposal of carcasses

"Virtual stable" in forest

Carriers or Survivors

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- **There is no general definition of an ASF virus carrier**
- There is no published evidence of any significant role in the ASF epidemiology of such carriers.
- There are two types of “survivors”:
  1. *chronically infected pigs*
  2. *pigs which clear the infection independently of virulence of the virus*
- None of the categories of survivors can be considered as “healthy” carriers, i.e. pigs that show no sign of disease but can transmit the virus to in-contact pigs
- Localized virus persistence in lymphoid tissues may occur to some extent in any of the categories of survivors, which in theory may cause infection after oral uptake.
- **To what extent this is relevant in reality, however, can be questioned**

The appearance of animals with a prolonged chronic course on the Iberian Peninsula has been associated with the vaccination studies based on live attenuated ASFV strains performed during the 1960s

Stahl K, Sternberg-Lewerin S, Blome S, Viltrop A, Penrith M-Louise, Chenais E, (2019). Lack of evidence for long term carriers of African swine fever virus – a systematic review, Virus Research (2019), doi: https://doi.org/10.1016/j.virusres.2019.197725

Vaccination

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Vaccine

- Purity
- Safety (field safety, residual virulence, overdose, shedding, risk to the environment…)
- Potency
- Efficacy (sterile immunity, protection from disease, only reduction of disease severity)

Vaccination strategy

- Prophylactic/metaphylactic
- Vaccination to live/kill
- Which animals (domestic, WB)
- Which age, how often
- Sustainability
- Administration (oral/parenteral)

"Thus the decision whether to recommend vaccination as a part of animal disease control strategy requires a thorough knowledge of the characteristics of the disease agent and its epidemiology, as well as the characteristics of the vaccines" (OIE)

Successful disease control requires a good vaccination strategy!!!

Lessons learned in recent years

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- **ASF in the field is not highly contagious**
  - *High case fatality (>90%)*
  - *Low (initial) mortality (<5%)*
  - *Low prevalence (<5%)*
  - *Not necessarily a density dependent process*
- **Slow spreading with side fidelity *(habitat disease)***, easy to control in domestic pigs, difficult in wild boar
- **Survivors are not necessarily carriers and carriers are not shedders:** no epidemiological relevance in an epidemic without tick involvement
- **Early detection only by passive surveillance**

- **Biosecurity the only potent tool to control ASF**
- **ASF is a human driven disease**

Humans are the main cause of long distance transmission and virus introduction into pig farms. Thus, it is crucial to include social science when planning prevention, control or eradication measures.

By considering only the biological particularities of the disease ….

but ignoring the human aspects, the epidemic will not be controlled.

Chenais E, Depner K et al. 2019

Thank you for your attention!!!