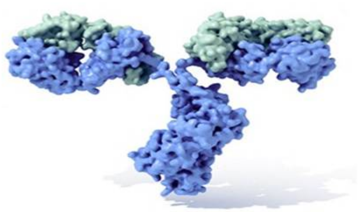
he “ideal” diagnostic test is accurate, reliable, sensitive, specific, and
onsistent (repeatable) and is cost effective (i.e. the costs are balance
y the usefulness of the information derived). Preferably the idea
liagnostic test will work on easily obtainable and easily preserve
pecimens. The specimens should preferably come from living animal
blood, feces, nasal swabs, etc.). Additionally, ideal diagnostic tests ca
e accurately performed locally (on farm, in veterinarian’s clinic or at a
egional lab).

n ideal diagnostic test for swine health would possess several key characteristics ensure accurate and reliable detection of diseases or health issues in pigs. Here e some of the essential criteria for an ideal swine diagnostic test:

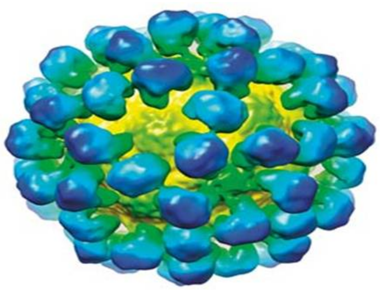
1. Sensitivity
2. Specificity
3. Rapid Results.
4. Cost-Effectiveness
5. Non-invasive or Minimally Invasive
6. User-Friendly
7. Accuracy
8. Long Shelf Life
9. Portability (on farm).
10. Ability to Detect Multiple Pathogens
11. Validation and Standardization
13. Regulatory Approval
14. Epidemiological Data to be used and take decisions

What?

INDIRECT DIAGNOSTIC
Antibodies detection



DIRECT DIAGNOSTIC
Antigen detection



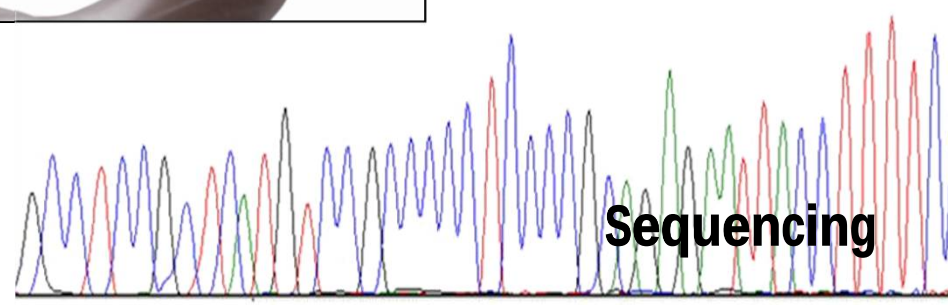
INDIRECT DIAGNOSTIC
Antibody detection

LISA

DIRECT DIAGNOSTIC
Antigen detection

Bacteriology

PCR



Sequencing

INDIRECT DIAGNOSTIC
Antibodies detection

ELISA

- Herd screening
- Serum profiles
- Vaccination response
- Gilt acclimatization success

Pros:

- Cheap
- High throughput volume
- Speed

Cons:

- Variable specificity and sensitiv
  depending on the test

- Individual Disease diagnosis
- Antibiotic resistances and treatment
- Autogenous vaccines development

Pros:

- Cheap

Cons:

- Sensitivity and Specificity depending on the bacteria (alive or not)
- Sampling is crucial

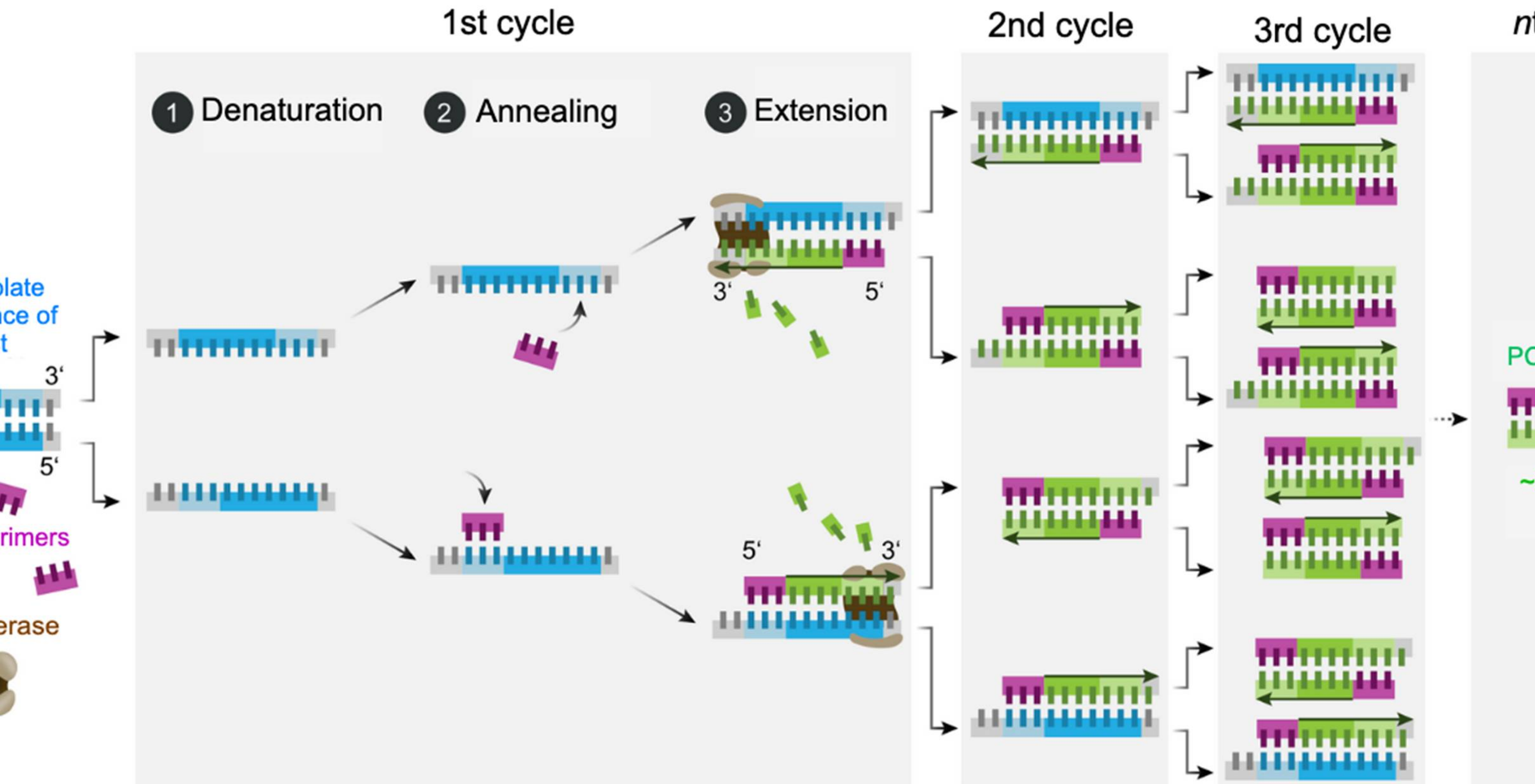
DIRECT DIAGNOSTIC
Antigen detection

DIRECT DIAGNOSTIC
Antigen detection

ection and selective amplification of a
ment of the virus/bacteria:

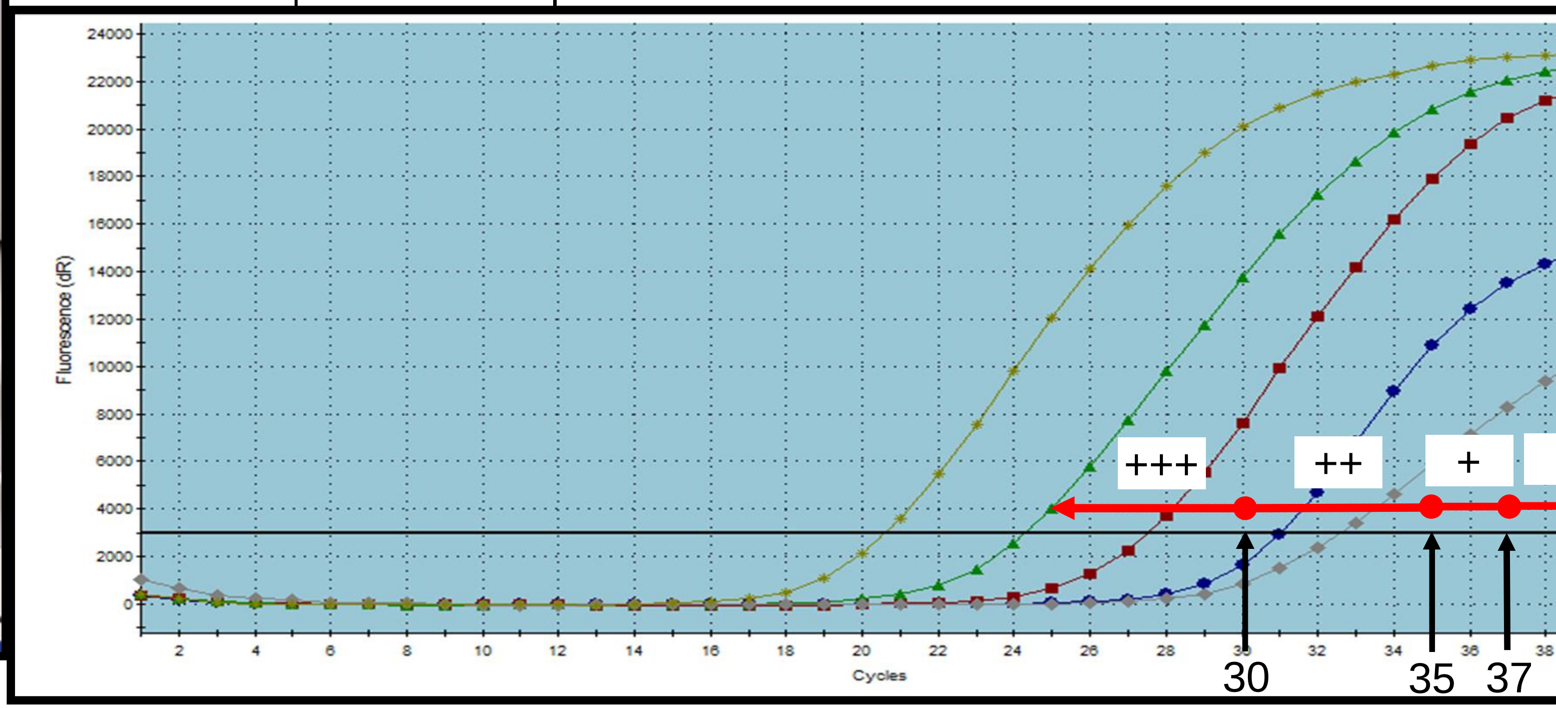
- Known
- Unique / Specific
- Conserved

PCR


1st cycle
1 Denaturation
2 Annealing
3 Extension
3‘
5‘
5‘
3‘
2nd cycle
3rd cycle
3‘
5‘

Ct value

Ct value	Score	Interpretation
≤30	**+++**	High quantity of DNA detected
>30≤35	**++**	Medium quantity of DNA detected
>35≤37	**+**	Low quantity of DNA detected
>37	**-**	No DNA detected



DIRECT DIAGNOSTIC
Antigen detection

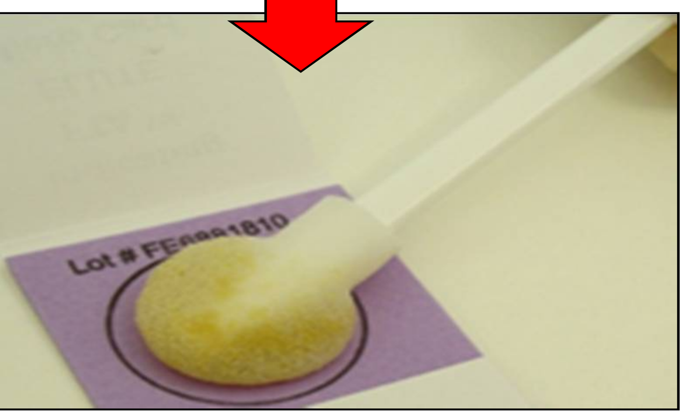
- Detect of DNA/RNA of targeted pathogen
- Disease surveillance and monitoring
- Biosecurity monitoring
- Gilt acclimatization success

Pros:
- High sensitivity
- Multiplexing
- Early disease detection
- Quantification

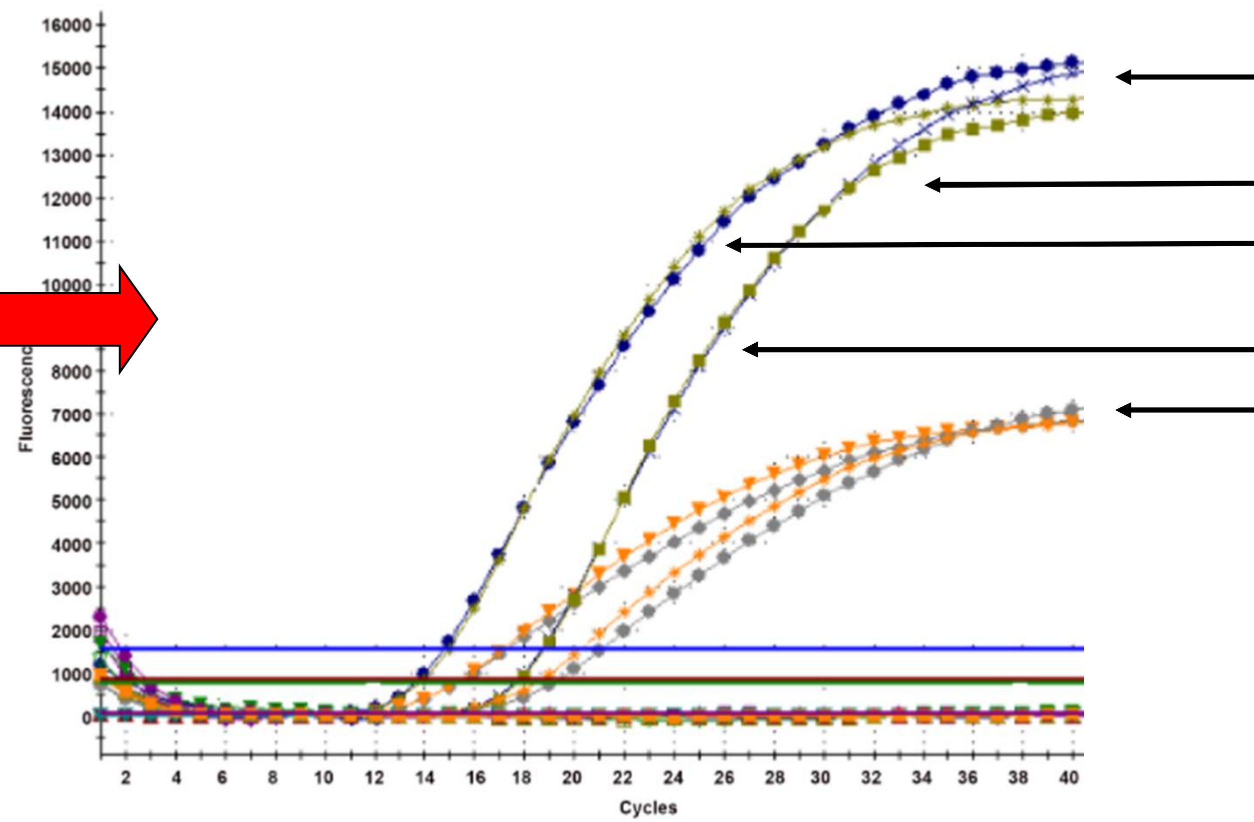
Cons:
- Expensive
- Sample contamination

PCR

tiplexing: Enteric colibacilosis



Detection of virulence factors. PCR



Piglet Enteric Diseases FTA card sampling

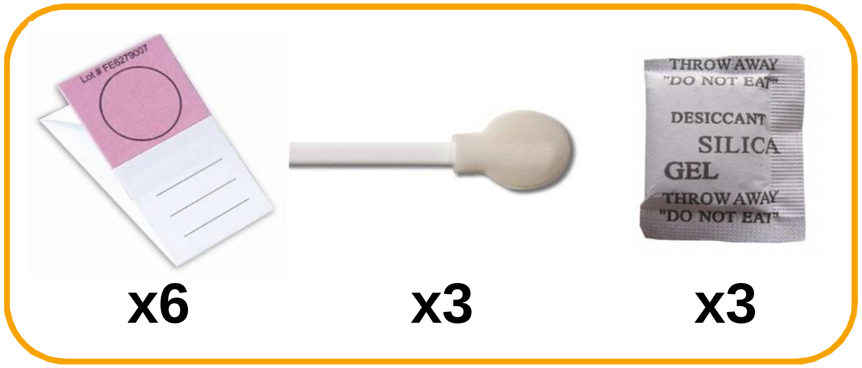
E.coli
F4 / F5 / F6 / LT

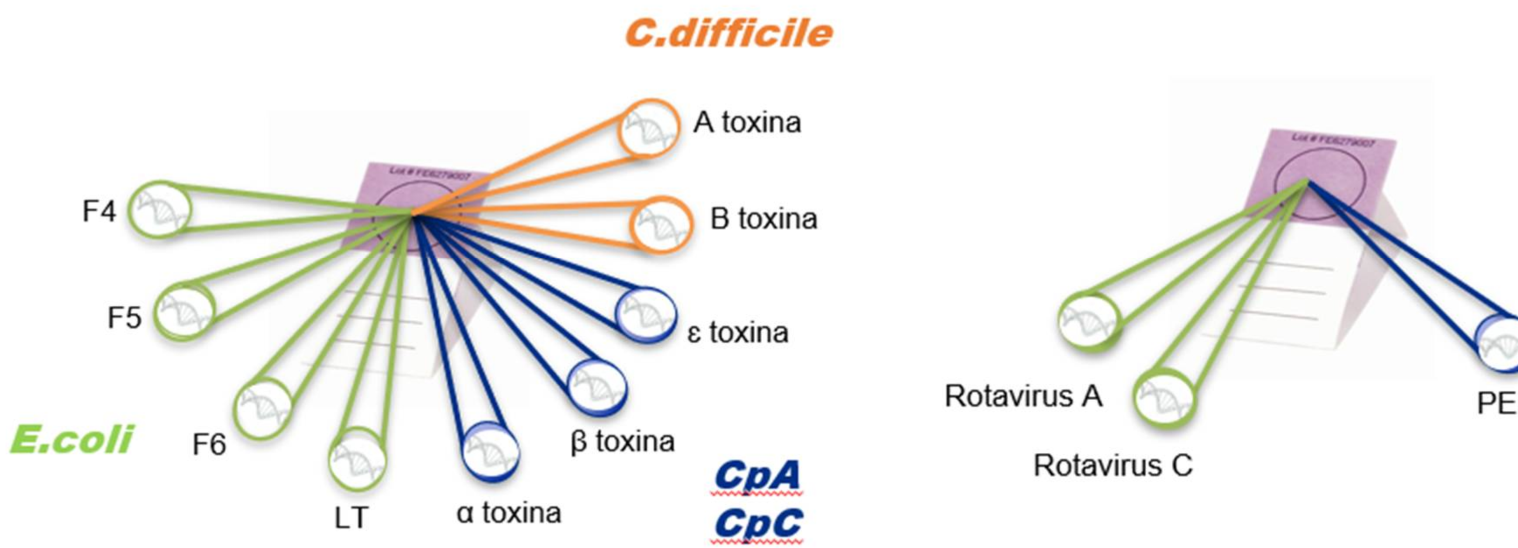
C.perfringens
α / β / ε

C.difficile
A / B

Rotavirus
A / C

PED





PCR from ORAL Fluids

PRRSV, SIV, ASFV, CSFV, PPV, PCV2, PCV3, hev, PEDV, PDCoV, SVA MHYO, *Bordetella bronchiseptica, Pasteurella multocida*, *E. Coli* VTEC.

RNA viruses very temperature and time sensitive

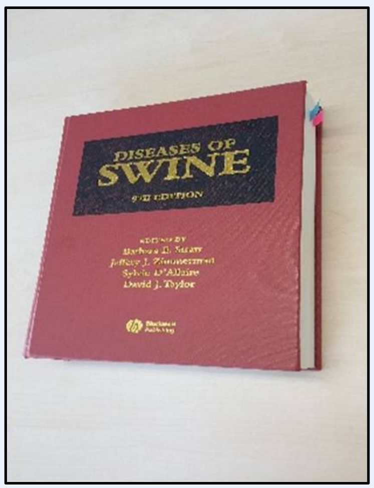
Easy monitoring of large populations

EDEMA Disease Oral Fluids Test

sics of Sequencing (ORF5 PRRS)

w is it performed?

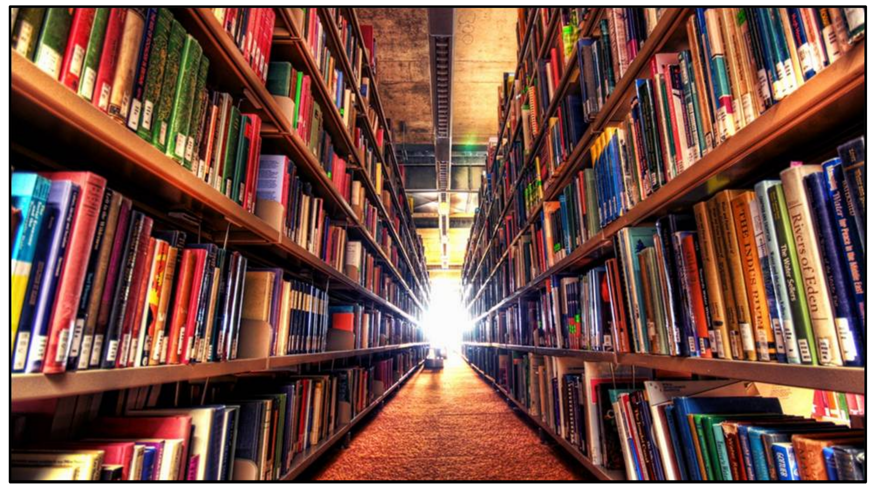
PARTIAL



Specific known Genome segment

Sanger

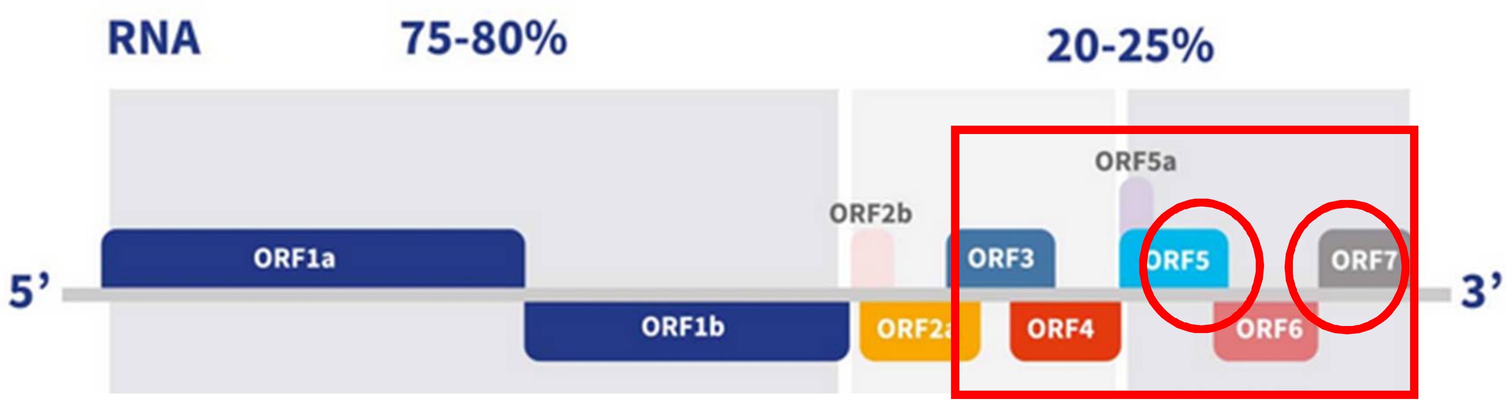
COMPLETE



Complete Genome of all the microorganism from the sample

Next generation sequencing (NGS)

Basics of the sequencing



RRSV genome: 15,300 bases

RF7: 387 b (2,5%) → RT-qPCR → **DETECTION**

RF5: 606 b (4%) → RT-qPCR + Sanger sequencing → **CARACTERIZATION**

RF2-7: 3.200 b (21%)→ RT-qPCR + secuenciación NGS → **RECOMBINANTS ANALYSIS**

ow is it performed?

le datos
nalizada

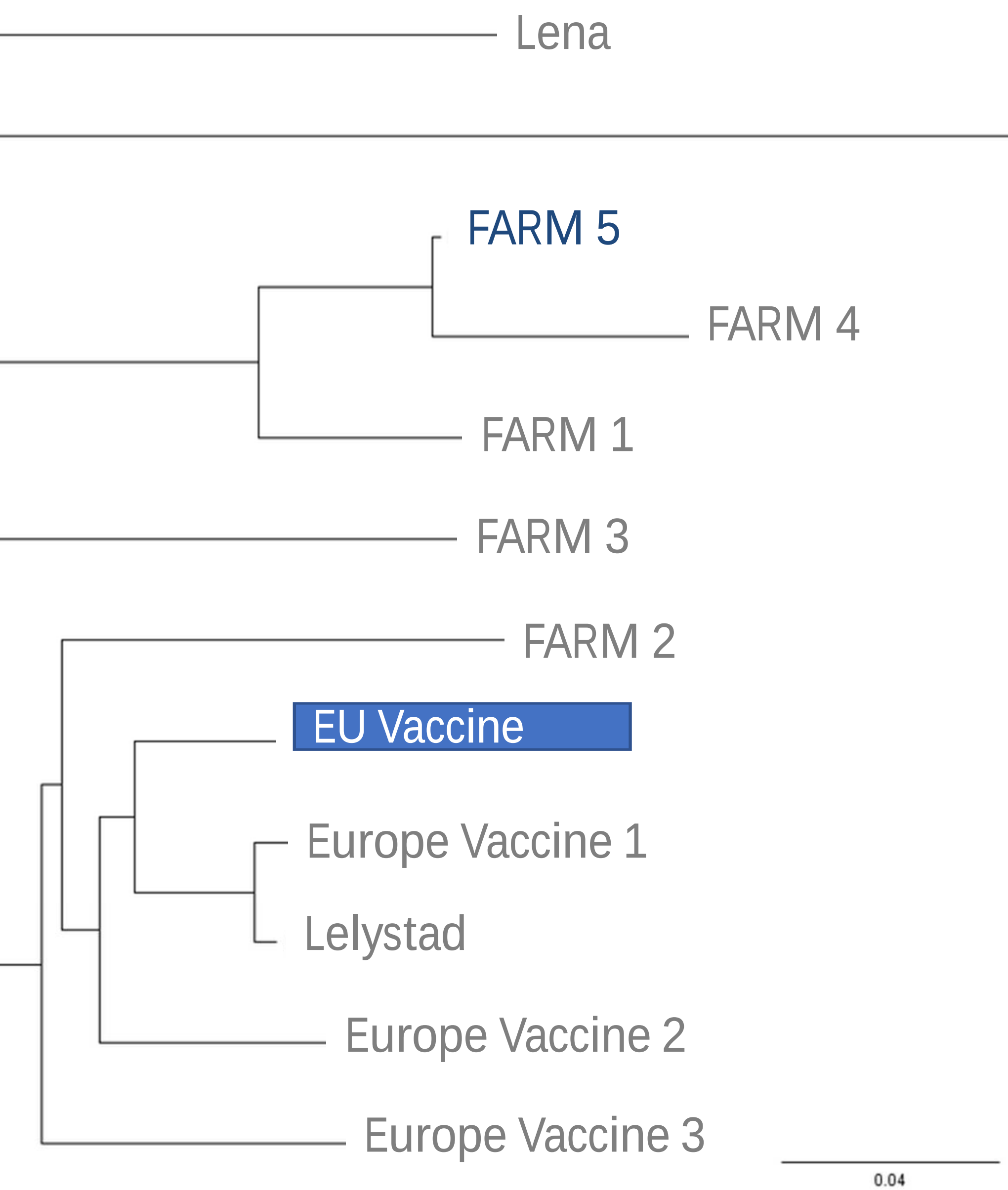
cunales

epas de
ferencia

	FARM 5	FARM 4	FARM 3	FARM 2	FARM 1
FARM 5		94.884%	83.003%	83.828%	93.069%
FARM 4	94.884%		79.703%	80.033%	88.449%
FARM 3	83.003%	79.703%		80.693%	84.158%
FARM 2	83.828%	80.033%	80.693%		83.828%
FARM 1	93.069%	88.449%	84.158%	83.828%	
EU Vaccine	87.459%	83.333%	84.323%	89.439%	86.469%
Europe vaccine 1	87.459%	83.993%	85.149%	88.779%	86.799%
Europe vaccine 2	86.304%	82.343%	84.818%	86.139%	85.314%
Europe vaccine 3	83.333%	79.538%	84.818%	85.809%	82.343%
Lelystad strain	87.624%	83.828%	85.314%	89.109%	86.964%
Lena strain	81.353%	77.393%	81.188%	82.673%	80.693%
VR-2332 strain	64.521%	61.551%	63.531%	63.366%	63.531%

Identidad nucleotídica (%)

Cómo se hace la secuenciación?



Árbol filogenético

Phylogenetic reconstruction me
Distance matrix. NEIGHBOR-JOINING alg

Why? Start with the Basics.

1. Surveillance: Testing expected negative farms for a particular pathogen. (Farms expected negative)

2. Monitoring: Testing positive farms for a particular pathogen

3. Disease Investigations: Farms with clinical disease of unknown causes

Classifying PRRSV Farm status using PCRs

SAMPLING (BLOOD)
30 (pre)weaned piglets
(x4 consecutives times / 90 days)
(sera → PCR)

RT-PCR
6 (x5) pools

All negative: **STABLE**
(no vertical transmission)

Just one positive:
UNSTABLE

PRRS virus circulation in farrowing unit

Holtkamp

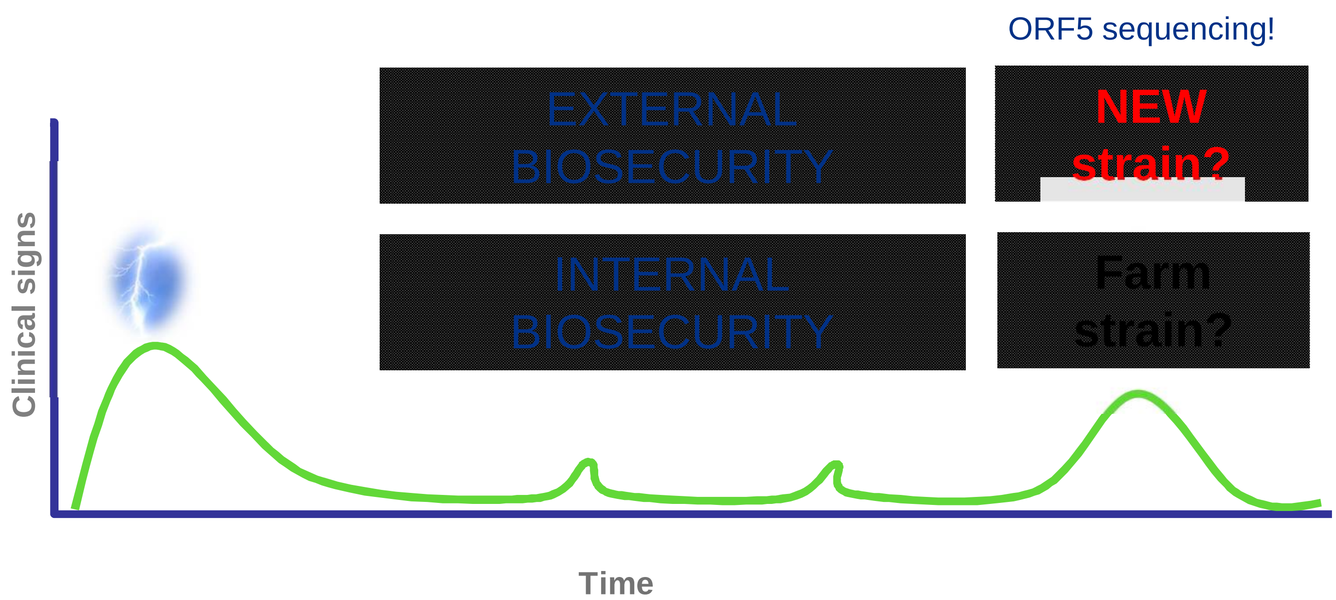
ORF5 sequencing: when?

1. **Homology between strain and phylogenetic tree:**
    - ¿Similarity to a vaccine strain? ¿Or a reference strain?
    - ¿Similarity to a previously detected strain in the same farm/company? ¿Region?

2. **Taking better decisions about management and biosecurity:**
    - ¿The outbreak has been caused by a new strain? ¿Already detected strain in the past?

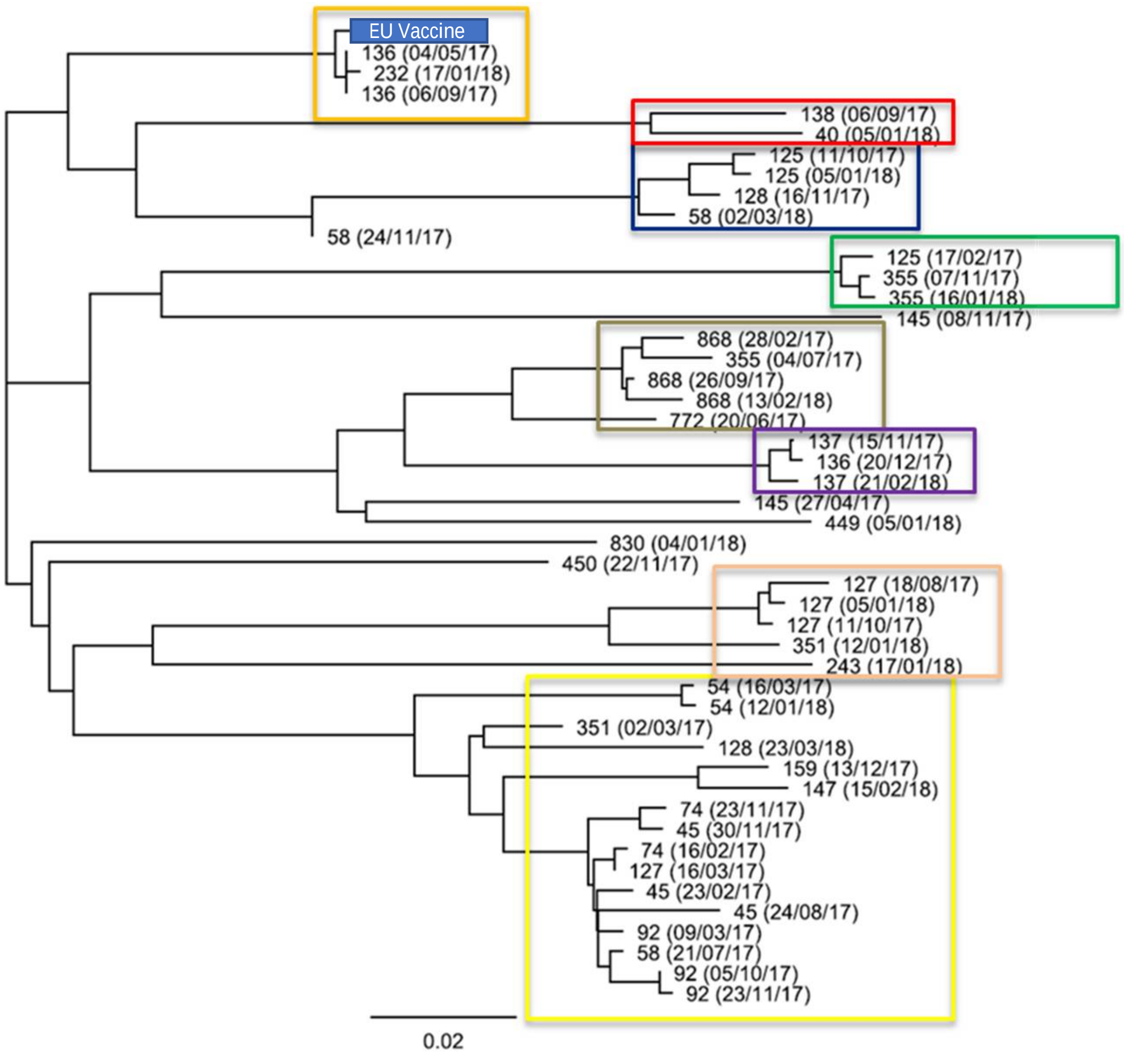
3. **PRRS strains mapping in a company/region**
    - ¿Which strains do they have in common? ¿Which strain shows the highest or quickest dissemination?

4. **It´s not useful for predicting vaccine efficacy**
    - A higher similarity between field strain and vaccine strain doesn´t mean higher protection/efficacy.



Perform **routine sequencing** minimum once a year

ORF5 Phylogenetic study



ORF5 sequencing is a extremely good help to understand where we need to put the focus: external biosecurity or internal biosecurity

Farm	January	February	March	April	May	June	July	August	September	October	November	Dicember
1												
2												
3												
4												
5												
6												
7												
8												

ssprotection conferred by each
MLV PRRS VACCINES can be
redicted by using sequencing?

No!

INAL RESEARCH PEER REVIEWED

nic homology of ORF 5 gene sequence between
ed live vaccine virus and porcine reproductive and
tory syndrome virus challenge isolates is not predictive
ine efficacy

nig, DVM; Francisco J. Pallarés, DVM, PhD; Dachrit Nilubol, DVM, PhD; Amy L. Vincent, DVM, PhD; Eileen L.
M, PhD, Diplomate ACVM; Eric M. Vaughn, DVM, PhD; Michael Roof, DVM, PhD; Patrick G. Halbur, DVM, PhD

ELSEVIER

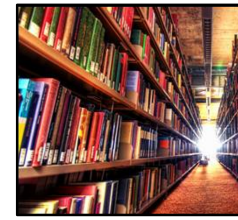
The Veterinary Journal

Volume 175, Issue 3, March 2008, Pages 356-363

Similarity of European porcine reproductive and respi
syndrome virus strains to vaccine strain is not necess
predictive of the degree of protective immunity confer

Cinta Prieto, Esther Álvarez, Francisco J. Martínez-Lobo, Isabel Simarro, José M. Castro

Next Generation Sequencing Applications



1) Viral Discovery

2) Pathogen Characterization

CASE 1: Outbreaks of vesicular disease in 2014 in Brazil

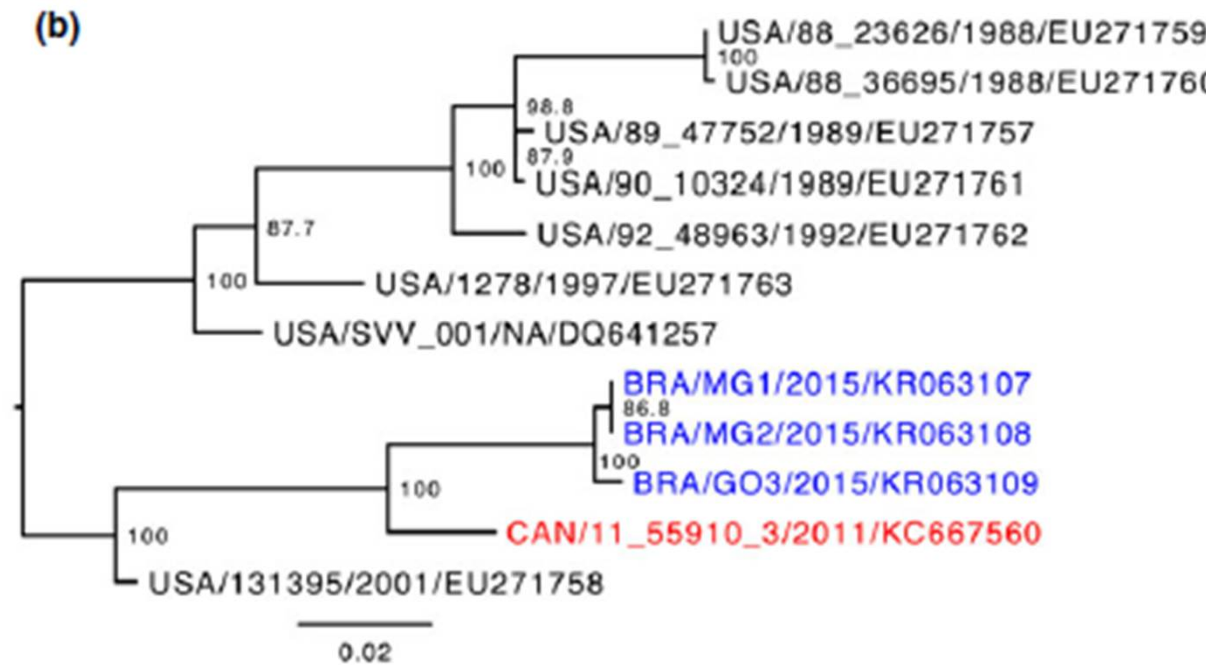
annucci et al. 2015. Transbound Emerg Dis 62(6):589-93.

CASE 1: Outbreaks of vesicular disease in 2014 in Brazil

NGS:

Seneca Valley Virus

(Senecavirus A)



Vannucci et al. 2015. Transbound Emerg Dis 62(6):589-93.

A

1) Viral Discovery

2) Pathogen Characterization
   - Comparison of two or more genomes
   - Recombination analysis
   - Typing
   - Prediction of virulence
   - Prediction of antibiotic resistance
   - Prediction of immune response

CASE 2: PRRSV re-break in a sow farm

Original outbreak: 1-7-4 PRRSV

Serum inoculation + herd closure, farm stable

Recent outbreak: 1-7-4 PRRSV,   98.5% similar (Orf5)

Is this the same strain?

CASE 2: PRRSV re-break in a sow farm

First PRRSV outbreak: PARTIAL genome sequence

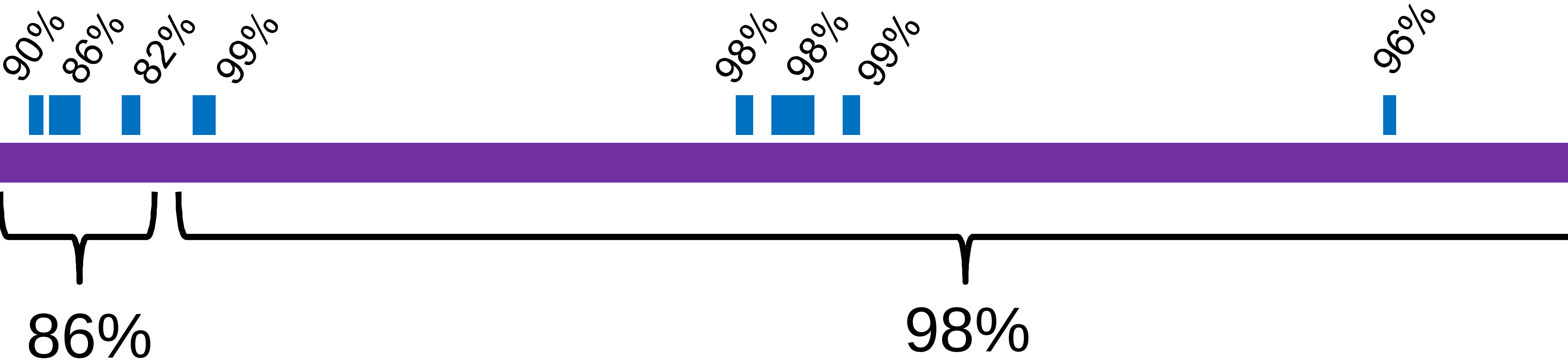
- 9 Contigs (fragments) - 118-370 nt
- 11% of the genome

Second PRRSV outbreak: whole genome sequence

ORF5 comparison: 98.5% similar

Partial genome comparison: 94.2% similar

CASE 2: PRRSV re-break in a sow farm



CASE 2: PRRSV re-break in a sow farm

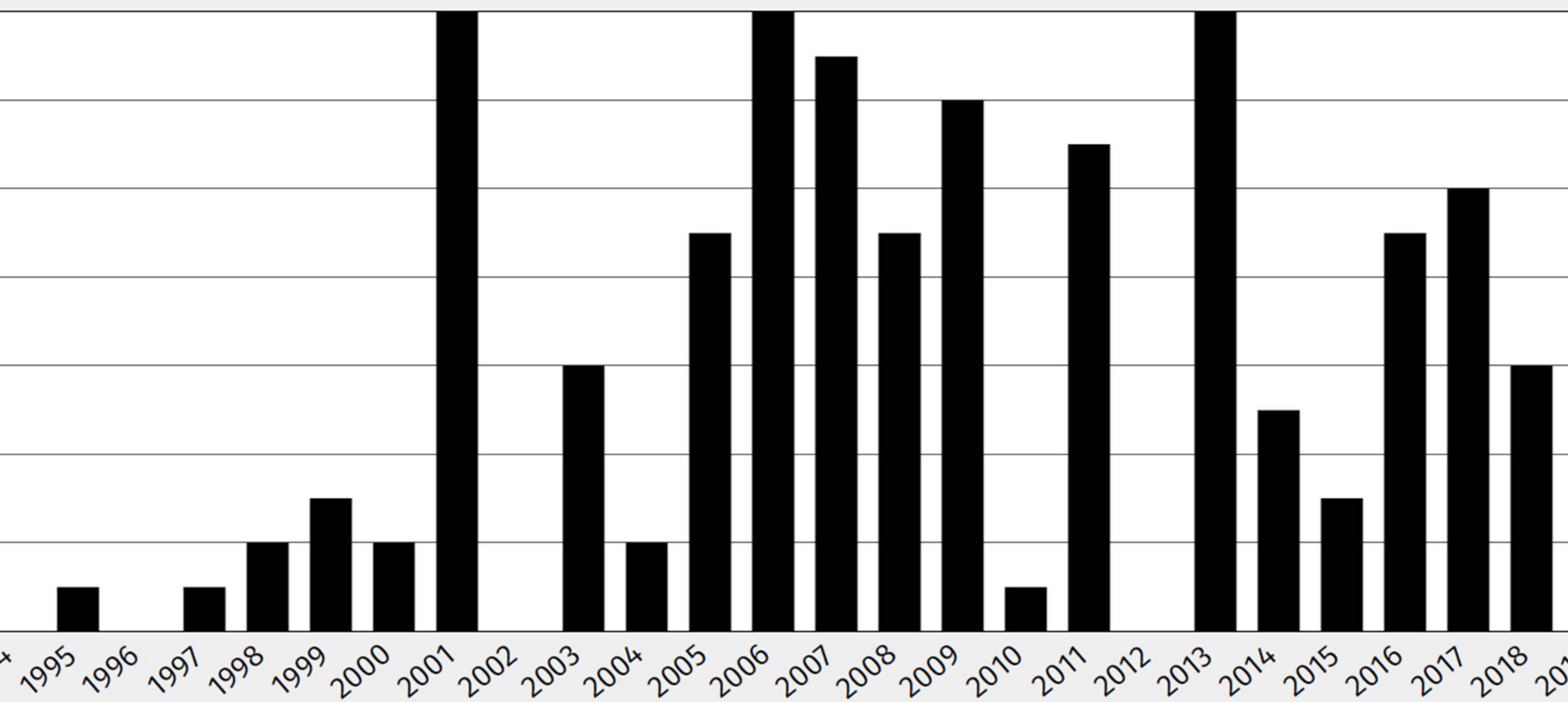
The first and second outbreaks were caused by different strains of PRRSV

Where did the second strain come from? Lateral introduction? Recombination?

Orf5 vs Whole Genome

	ORF5	WHOLE GENOME
Genome coverage	4%	**100%**
Turnaround time	**2 days**	2 weeks
Cost	**$100**	$350
Success rate	**High**	Medium
Databases	**Excellent**	Poor

New porcine molecular procedures introduced per year. University of Minnesota Veterinary Diagnostic Laborat



- Increase Data Analysis from lab results
- Artificial Intelligence
- PRECISION LIVESTOCK FARMING
- POINT OF CARE=need

Data Analytics in Animal health

SDRS

NE DISEASE REPORTING SYSTEM

DECIDE

About

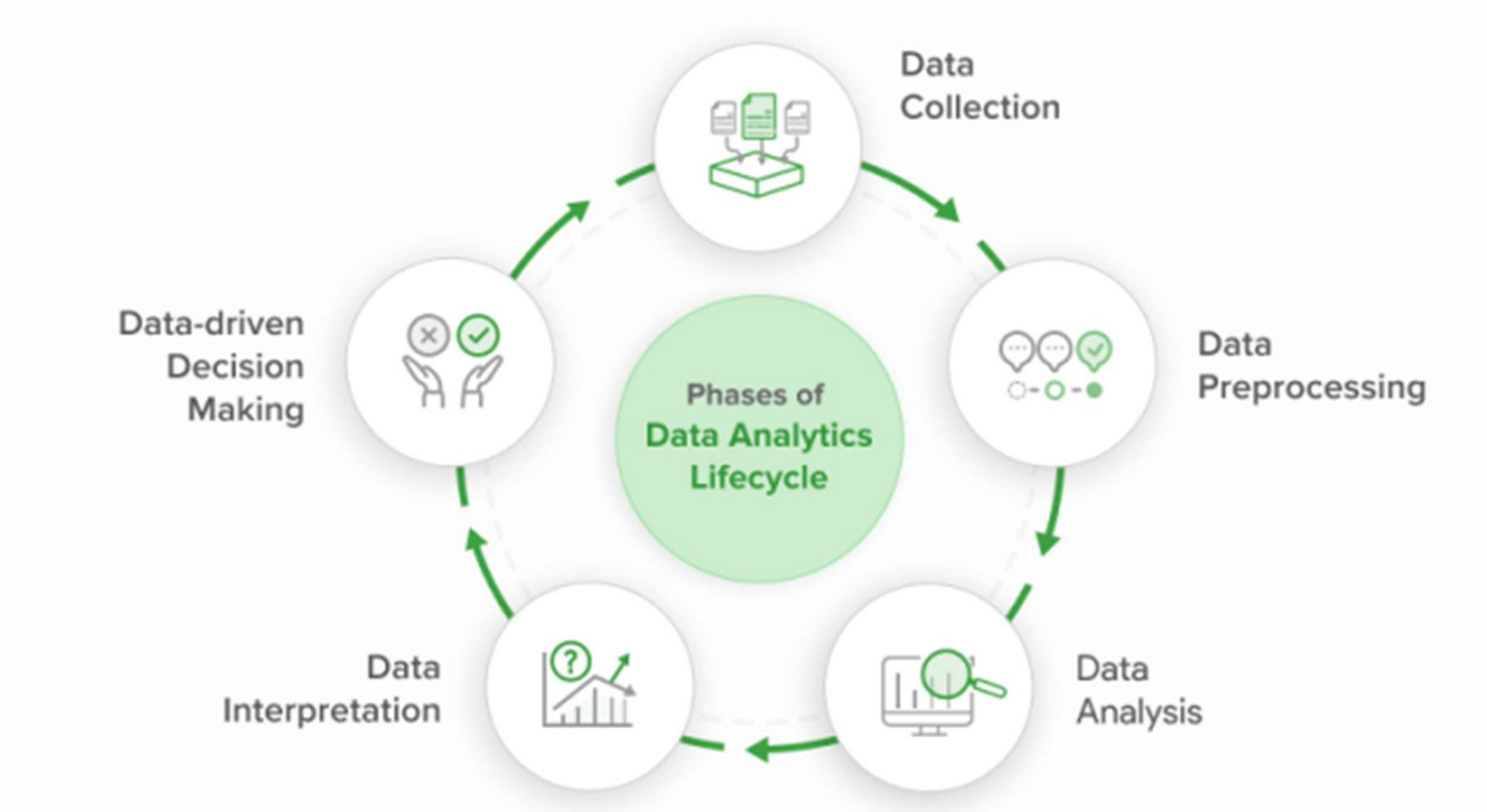
Data-driven control and prioritisation of non-EU-regulated contagious animal dise

MSHMP

Morrison Swine Health Monitoring Project

A

Data Analytics in Animal health



coring of swine lung lesion images by an artificial intelligence algorithm: A comparison to human expert
tors

ter: Robert Valeris-Chacin
ponding Author: Maria Pieters, University of Minnesota, St. Paul, MN, USA
(s): Robert Valeris-Chacin, Beatriz Garcia, Marina Sibila, Albert Canturri, Isaac Ballarà Rodriguez, Ignacio B
, Ramon Jordà Casadevall, Maria Pieters

IPVS2022
26th international pig veterinary society congress - rio de janeiro - brazil

Artificial intelligence as a new method of assessing enzootic pneumonia and atrophic rhinitis lesions

A

dvantages of using AI in lung scoring:

tomated: it only requires taking photos and upload them in the system, so we do not need to send ecialized technicians to the slaughters.

liable: it is a fully objective process, where the subjectivity of the evaluators is eliminated, and the ages are always evaluated according to the same set of criteria and levels of accuracy, so the stem is standardizing the process of lung scoring and snout lesions assessment.

nple: it is a very user-friendly system, where only the farm data has to be completed and the ages of the lungs or nasal turbinates' must be added for the system to perform the evaluation tomatically. The system generates a report automatically to make interpretation easier for the user.

POINT OF CARE

POC diagnostics are analytical devices and other tests that provide rapid
diagnostic capabilities, without the need for core laboratory facilities

he emergence of novel pathogens, the modern farming systems, and the
omplexity of globalized supply chains and trade networks make animal
roduction susceptible to disease outbreaks.

Rapid, low-cost, and reliable field diagnosis is gradually becoming
ndispensable to support evidence-based disease-control strategies in
eterinary medical practice.

A

Manessis et al,.

Lateral Flow

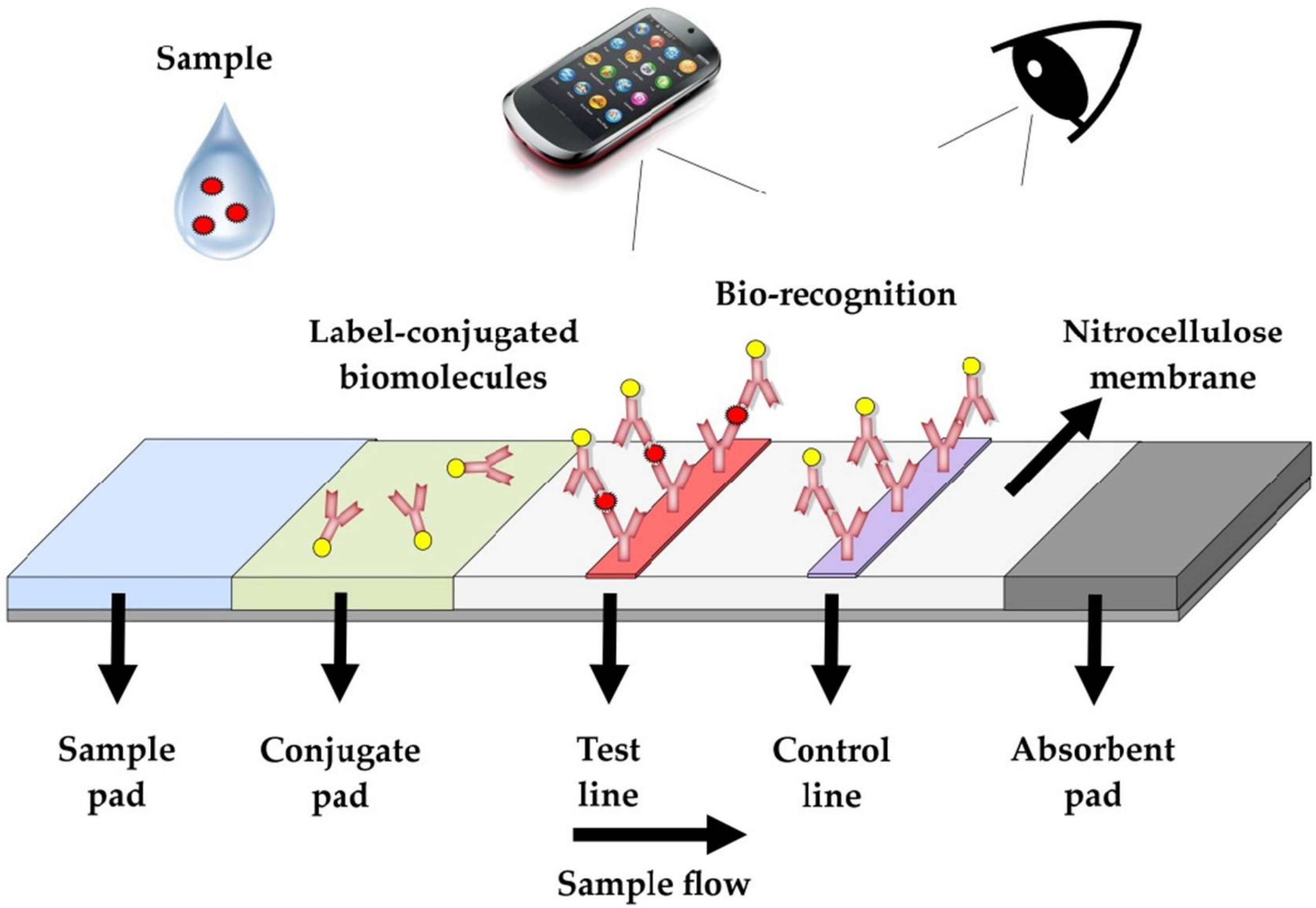
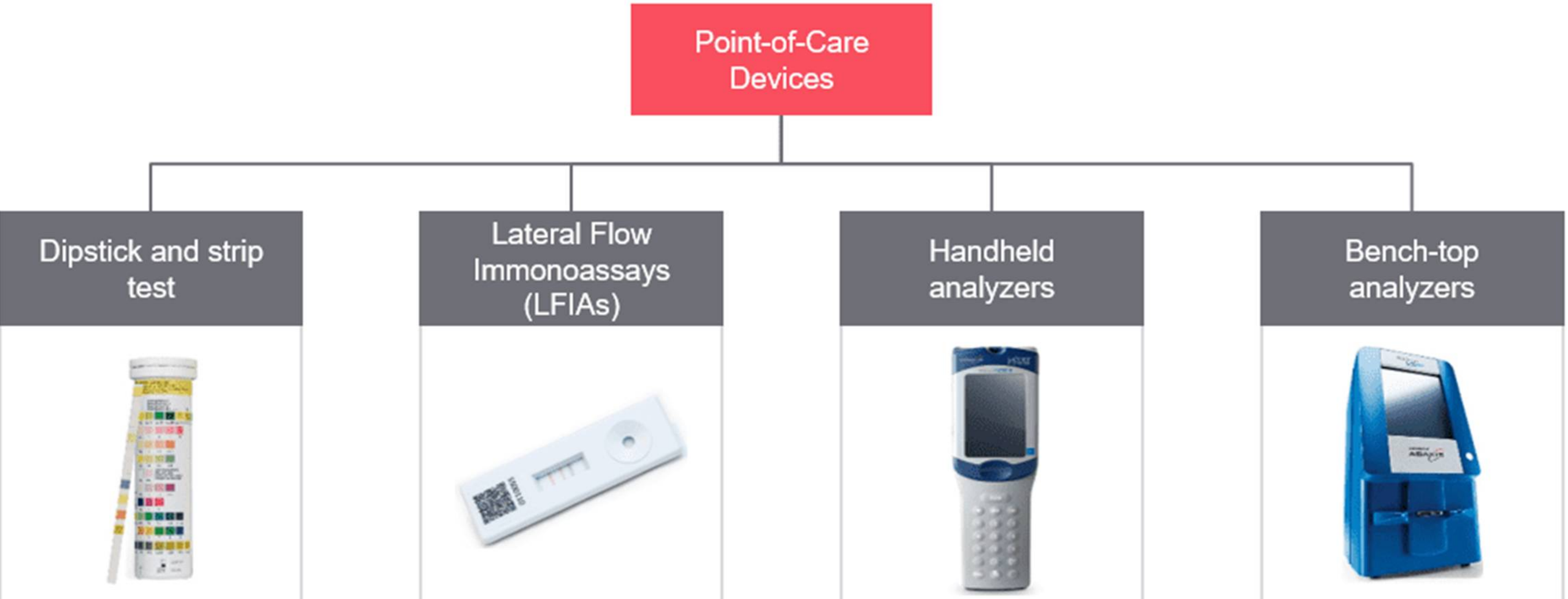


Figure 1. Principle of LFA sandwich format.

HIBIT 1: Classification of PoC Devices



e: Secondary Research

Challenges of POC

- POC diagnostics should focus on validation using complex clinical samples and large animal populations
- POC diagnostics must be low-cost and simple.
- POC devices should be portable and multiplexed.
  - Only a few POC devices targeting bacteria, protozoa, and parasites have been developed,

Manessis et al,.

DEFINITION OF PRECISION LIVESTOCK FARMING (PLF)

PLF

Manage individual animals by ***continuous*** real-time monitoring of health, welfare, production/reproduction and environmental impact

Real-time measuring and analyzing which provides warnings and direction to the area of needed attention – actionable

A SET OF TOOLS THAT ALLOWS EWER PRODUCERS TO MONITOR MORE ANIMALS.

CAN BE USED TO MONITOR ANIMAL HEALTH AND WELFARE AND REDUCE ENVIRONMENTAL IMPACT WHILE ASSURING THE PRODUCTIVITY IN THE PROCESS (PUBLIC PERCEPTION)

IS A MULTIDISCIPLINARY SCIENCE T REQUIRES COLLABORATION AMO ANIMAL SCIENTIST, PHYSIOLOGIS VETERINARIANS, ETC.

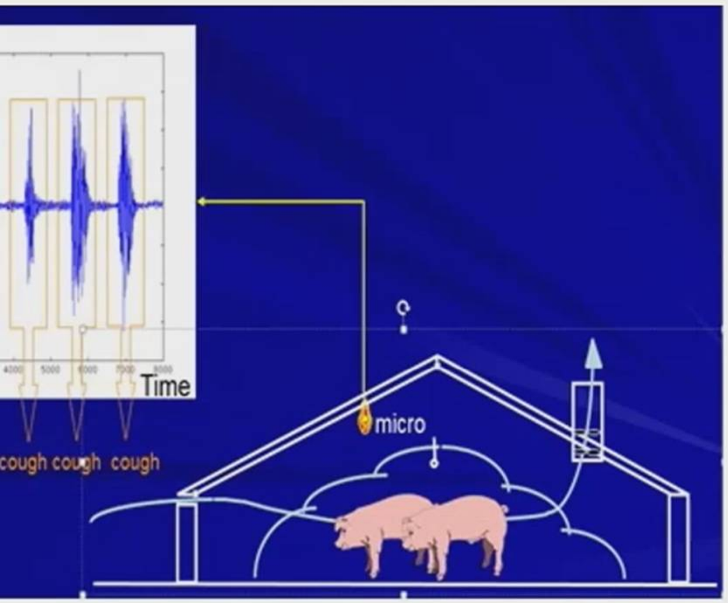
Farm Health Guardian™

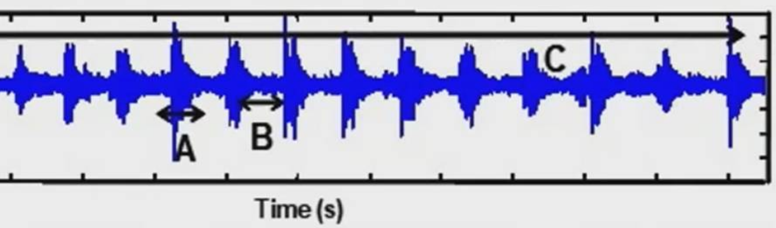
BOOST YOUR FARM BIOSECURITY

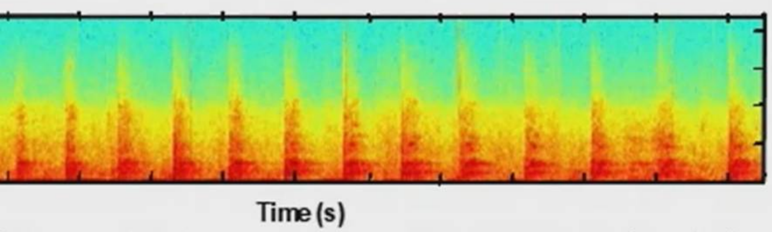
What are the benefits of using Farm Health Monitor?

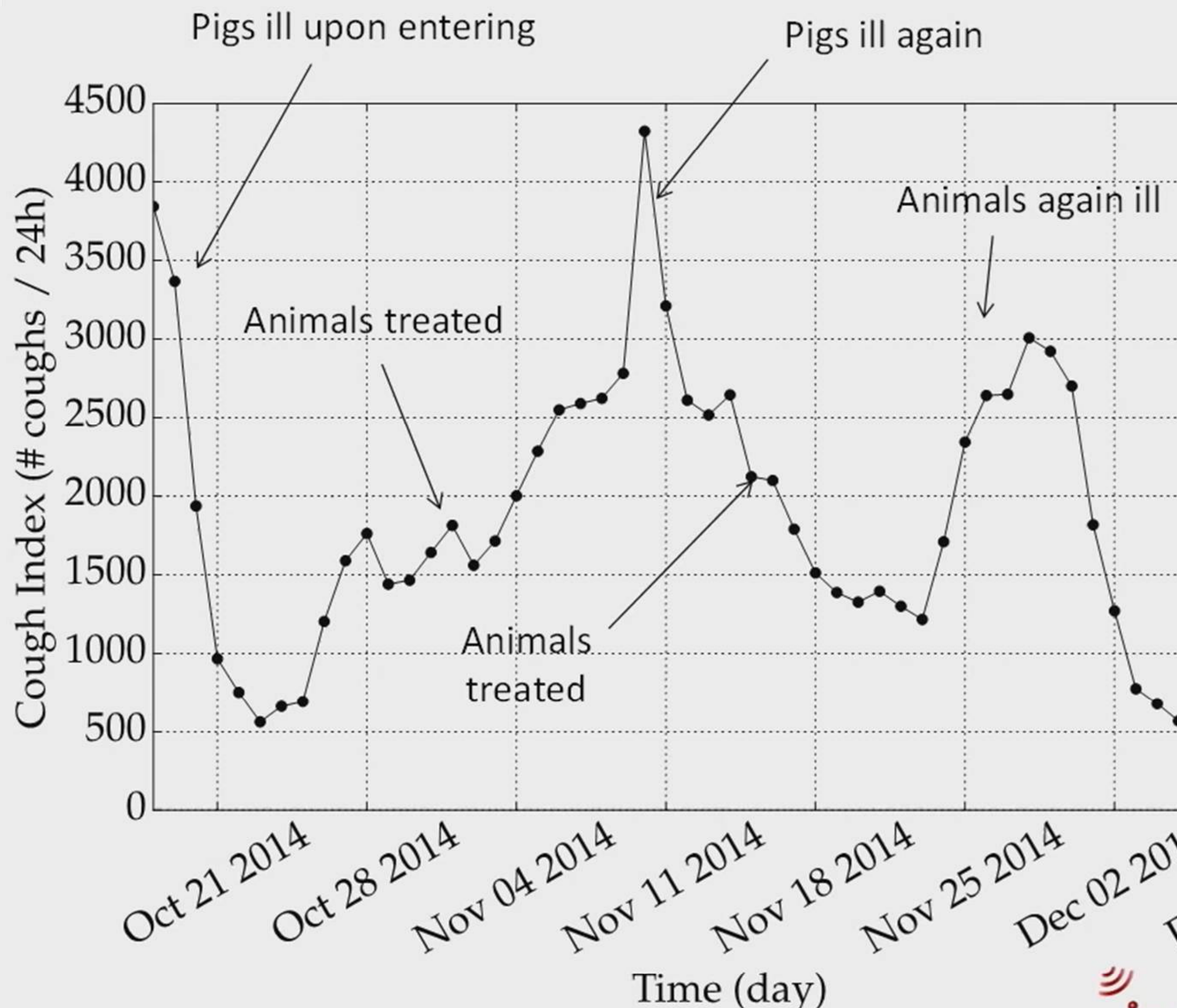
- **Early disease detection** with real-time input into cloud hosted health records and immediate and targeted communications
- **Accurate health and mortality tracking** with a digital recording and reporting health system
- **Increase efficiency** by connecting everyone on your animal health team and recording all information into one easily-accessible system

g Cough Monitoring









) In collaboration with UNIMI (Italy)

Started by Van Hirtum and Berckmans (2000)

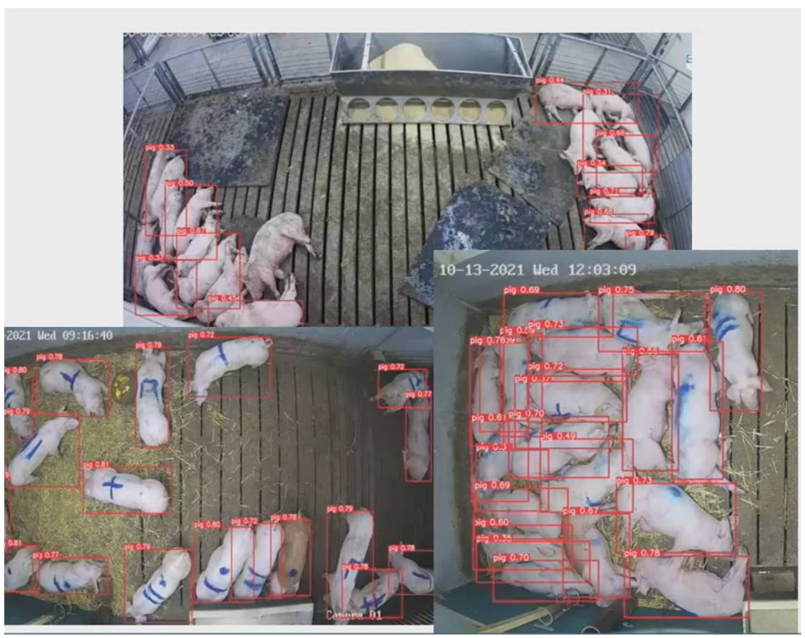
EU

FP7

The Future

- ntegrated pig production monitoring: Health/ welfare / productivity

- Jsing Cameras → 1 device per pig pen



Conclusions

The ideal test does not exist, it is necessary to combine different tests to find solutions to the clinical cases.

No way!! Nowadays, swine vets must be trained to use and interpret all the diagnostics tools available in order to make the best treatment decisions.

On Farm diagnostics and increase of sensors will bring the possibility to have earlier diagnostics without the need to wait lab results.