ASF on-farm surveillance: principles and concepts

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EpiX Webinar Series. April 2020

Acknowledgments

1. Jose Manuel Sanchez-Vizcaino, VISAVET Spain (surveillance)
2. Bob Morrison and Cesar Corzo, UMN (MSHMP)
3. Ana Alba, IRTA Spain (OptiSample)
4. Marie Culhane, Tim Goldsmith, and Carol Cardona, UMN (Continuity of business)

Summary

1. The concept of surveillance
2. Regulations vs useful information
3. Farms in a regional context
4. Continuity of business

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J Vet Diagn Invest 15:501–514 (2003)

SPECIAL ARTICLE

Conceptual foundations for infectious disease surveillance

Mark C. Thurmond

Definition of surveillance

Active, ongoing, formal, systematic, aimed at early detection of a specific disease or agent in a population or early prediction of elevated risk of a population acquiring an infectious disease, with a pre specified action that would follow the detection of disease.

Why we do it?

How much does it cost?

Why do we do it?

To comply with official regulations?	MARD
To estimate prevalence?	Farm-level
To demonstrate that a group of animals is free?	Movements. Ag or Ab?
To early detect the pathogen and prevent further spread?	Clinical + OF, PCR
To demonstrate that a group of animals is protected?	Not for ASF
To evaluate if a group of animals has been exposed to the virus?	Ab detection

Reflection:

Testing to comply with official regulations may not always meet on-farm surveillance goals.

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Regulations vs useful information - (MSHMP)

Dr. Bob Morrison started the SHMP as an initiative to share data to address knowledge gaps for PRRS in the US (non reportable)

Objectives

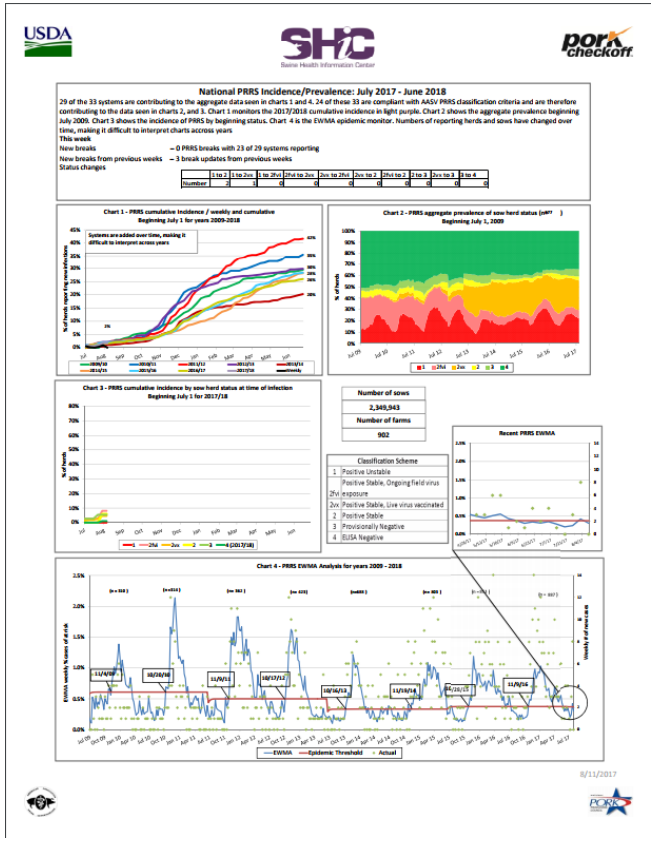
1. Long term - develop capacity to give industry opportunity to voluntarily respond to an emerging pathogen.
2. Short term - deliver value to producers and their veterinarians (such that they participate for long term objective).

Data

- 2009 & 2010 - retrospective
- January 2011 – prospective
- Pathogen year: July 1 → June 30

The MSHMP today

- 33 systems
  - 26 companies
  - 3 veterinary practice coordinated systems
  - 4 regional projects
- Participation
  - 1,092 sow farms & 2.958 m sows.
  - ~50% of U.S. sow population
- 25 companies and 4 regional projects share logo and are willing to share their premises IDs and pathogen status in the interests of national disease control

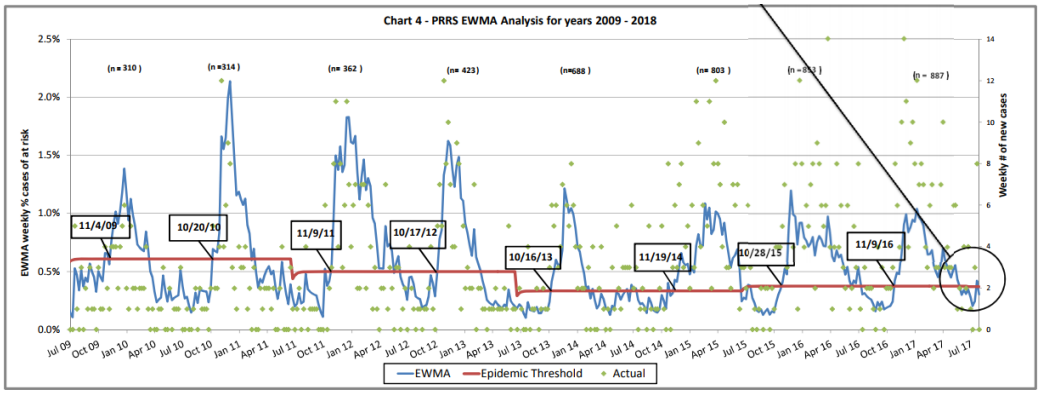


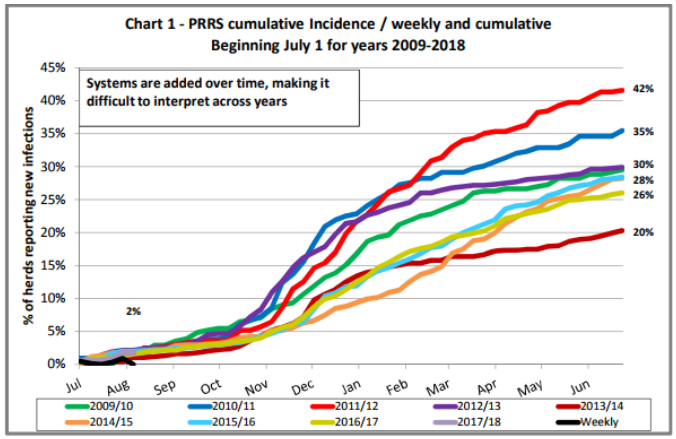
5 things the MSHMP helped us to learn

AJVR • Vol 76 • No. 1 • January 2015

Temporal and spatial dynamics of porcine reproductive and respiratory syndrome virus infection in the United States

Steven J. P. Tousignant DVM Andres M. Perez DVM, PhD James F. Lowe DVM, MS Paul E. Yeske DVM, MS Robert B. Morrison DVM, PhD





Can Vet J 2015;56:1087–1089

Comparison between the 2013–2014 and 2009–2012 annual porcine reproductive and respiratory syndrome virus epidemics in a cohort of sow herds in the United States

Steven J.P. Tousignant, Andres Perez, Robert Morrison

1. PRRS patterns at the national level

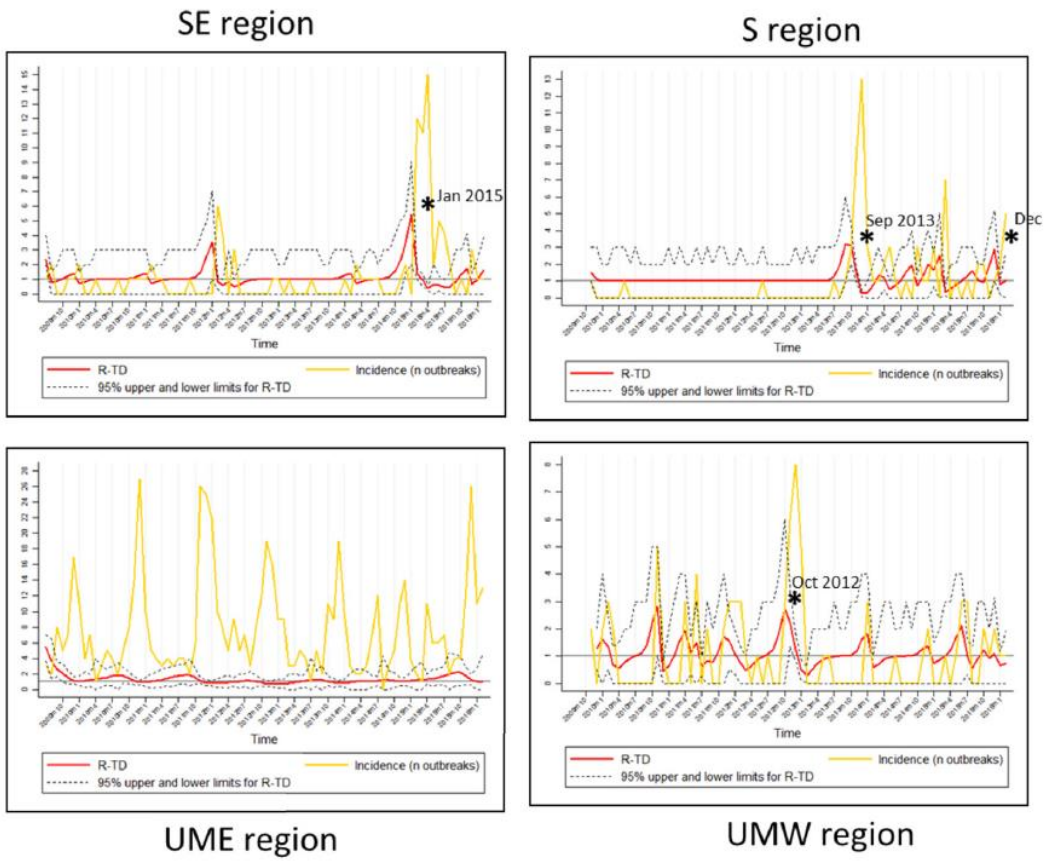
frontiers in Veterinary Science

ORIGINAL RESEARCH
published: 05 April 2017
doi: 10.3389/fvets.2017.00046

Estimation of Time-Dependent Reproduction Numbers for Porcine Reproductive and Respiratory Syndrome across Different Regions and Production Systems of the US

Andréia G. Arruda[1], Moh A. Alkhamis[2], Kimberly VanderWaal[1], Robert B. Morrison[1] and Andres M. Perez[1]*

2. Incidence varies among regions and the TDR can predict the emergence and decline of epidemics



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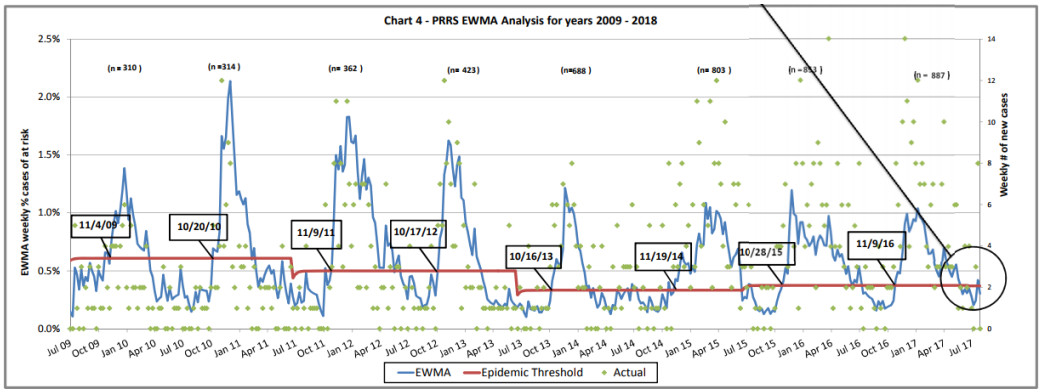


Preventive Veterinary Medicine xxx (2015) xxx–xxx

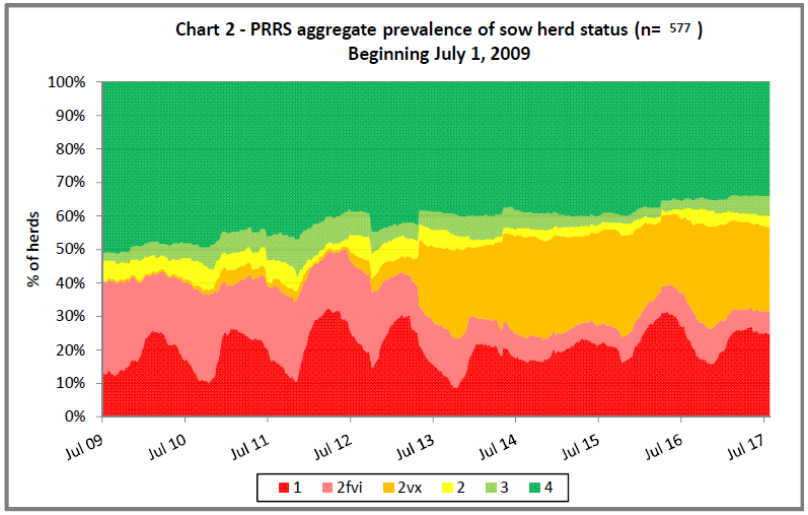
Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Association of the presence of influenza A virus and porcine reproductive and respiratory syndrome virus in sow farms with post-weaning mortality

Julio Alvarez[a,*], Javier Sarradell[b], Barry Kerkaert[c], Dipankar Bandyopadhyay[d], Montserrat Torremorell[a], Robert Morrison[a], Andres Perez[a]

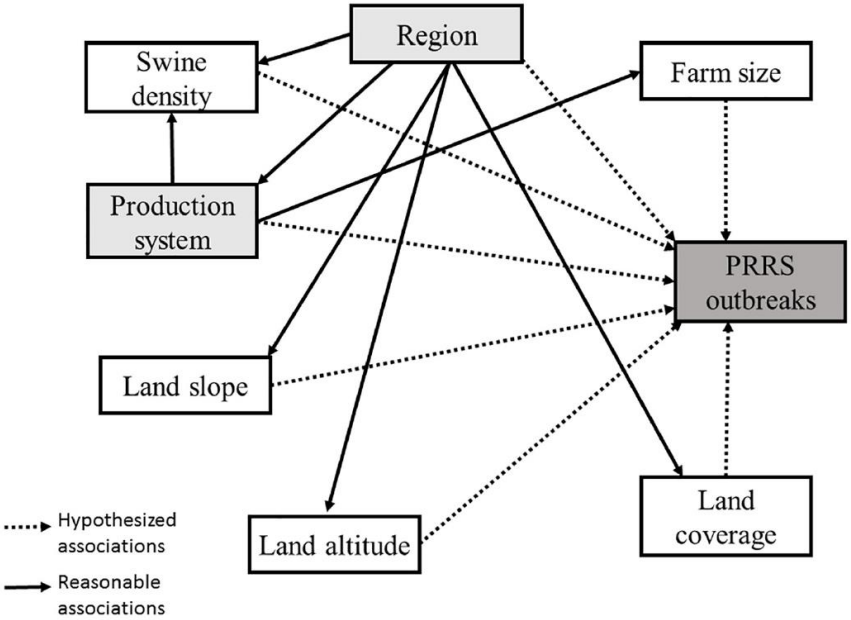


3. PRRS impact on production

PLOS | ONE

Land altitude, slope, and coverage as risk factors for Porcine Reproductive and Respiratory Syndrome (PRRS) outbreaks in the United States

Andréia Gonçalves Arruda*, Carles Vilalta, Andres Perez, Robert Morrison



4. Land slope, altitude, and coverage influence PRRS risk after accounting for swine density and size

Front. Microbiol., 02 February 2016 | http://dx.doi.org/10.3389/fmicb.2016.00067

Applications of Bayesian Phylodynamic Methods in a Recent U.S. Porcine Reproductive and Respiratory Syndrome Virus Outbreak

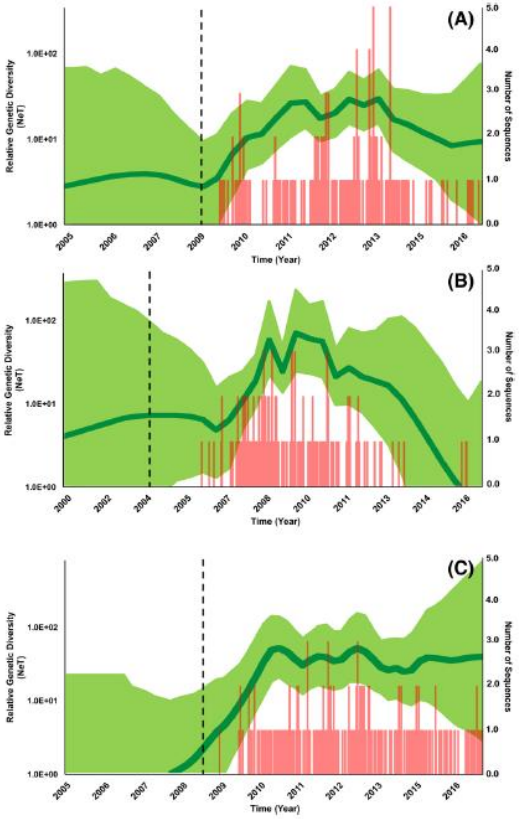
Mohammad A. Alkhamis[1,2*], Andres M. Perez[1], Michael P. Murtaugh[3], Xiong Wang[1,3] and Robert B. Morrison[1]

www.nature.com/scientificreports

SCIENTIFIC REPORTS

Novel approaches for Spatial and Molecular Surveillance of Porcine Reproductive and Respiratory Syndrome Virus (PRRSv) in the United States

Moh A. Alkhamis[1,2], Andreia G. Arruda[3], Robert B. Morrison[1] & Andres M. Perez[1]



5. Sequencing can help to identify emerging strains, evaluate spread between systems, and identify strain emergences

Reflection

- Should we comply with MARD requirements?

YES!

- Is it all I need?

One can look at MARD guidelines as the “minimum” required to comply with official regulations. One cannot do less than that, but depending on objectives and the epidemiological situation, one may need to augment the on-farm surveillance to meet the system goals.

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3. Farms in a regional context
4. Continuity of business

PLOS ONE

Optisample™: Open web-based application to optimize sampling strategies for active surveillance activities at the herd level illustrated using Porcine Respiratory Reproductive Syndrome (PRRS)

Anna Alba, Robert E. Morrison †, Ann Cheeran, Albert Rovira, Julio Alvarez, Andres M. Perez

Published: July 18, 2017 • https://doi.org/10.1371/journal.pone.0176863

https://final.shinyapps.io/optisampleTM/

What is the most efficient surveillance strategy?

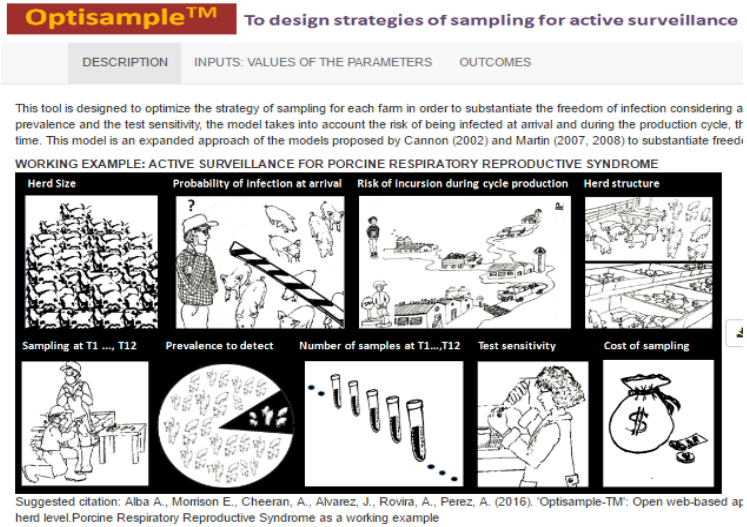
There is **not** a **unique answer**.

Depends on:

- **goal to achieve**
- **epidemiological circumstances**
- **management in the system**
- **cost**
- **etc**

Optisample™

FREE ACCESS SAMPLING DECISION SUPPORT TOOL



- to **assess the probability of being free of disease at herd level**

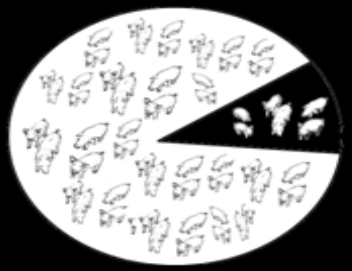
- to **compare the cost-effectiveness of different strategies**

INPUTS

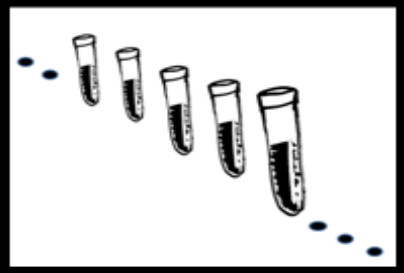
STRATEGY OF SAMPLING

Sampling at T1 ..., T12

Prevalence to detect



Number of samples at T1...,T12



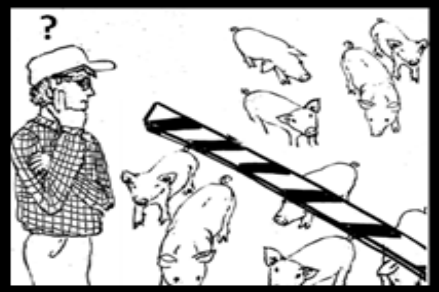
Test sensitivity

Price of each test

DEMOGRAPHIC and EPIDEMIOLOGICAL CONTEXT

Herd Size

Probability of infection at arrival



Risk of incursion during cycle production

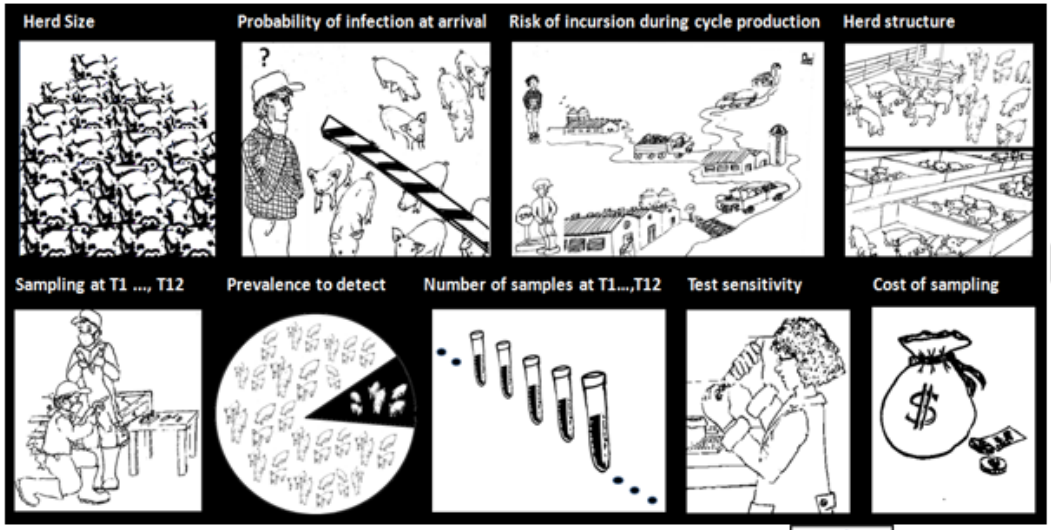
Degree of relatedness between sampled groups

Optisample™ To design strategies of sampling for active surveillance

DESCRIPTION | INPUTS: VALUES OF THE PARAMETERS | OUTCOMES

This tool is designed to optimize the strategy of sampling for each farm in order to substantiate the freedom of infection considering also the costs of testing. Apart from the herd size, the minimum prevalence to detect and the test sensitivity, the model takes into account the initial risk of being infected before conducting any sampling and during the production cycle, the structure of the herd and how the samples are selected over time. This model is an expanded approach of the models proposed by Cannon (2002) and Martin (2007, 2008) to substantiate freedom of disease at herd and population level.

WORKING EXAMPLE:
ACTIVE SURVEILLANCE FOR PORCINE RESPIRATORY REPRODUCTIVE SYNDROME



Examples

Manuscript

Please send any comments, questions or suggestions to:
Ana Alba: aalbac@hotmail.com
Andres Perez: aperez@umn.edu

Authors: Ana Alba & Andres Perez

University of Minnesota
College of Veterinary Medicine

STEMMA

DESCRIPTION | INPUTS: VALUES OF THE PARAMETERS | OUTCOMES

CHARACTERISTICS OF THE HERD

HERD SIZE:

3000

PROBABILITY OF PATHOGEN INFECTION BEFORE THE FIRST SAMPLING
History of disease occurrence available since (yyyy-mm-dd):

2017-05-03

Number of outbreaks occurred within this period:

0

In the event of outbreak, duration of the pathogen persistence in the herd (in days):

1 147 231 365

PROBABILITY OF PATHOGEN INCURSION DURING THE PRODUCTION CYCLE
How often would be expected an outbreak in this herd? (define a range of years):

1 3 15

CORRELATION BETWEEN SUCCESSIVE GROUPS OF SAMPLED ANIMALS FOR PREVALENCE OF INFECTION
Range:

0 0.2 0.7 1

CHARACTERISTICS OF THE SAMPLING

MINIMUM PREVALENCE TO DETECT:
(expected prevalence if the disease was present)

0.05 1

TEST SENSITIVITY:
Range:

0 0.8 0.9 1

Most likely value:

0.84

PRICE OF UNIT TEST:

0

FREQUENCY OF CONSECUTIVE TESTING:

Monthly

Number of samples at time 1:

0 30 300

Number of samples at time 2:

0 30 300

Number of samples at time 3:

0 30 300

Number of samples at time 4:

0 30 300

Number of samples at time 5:

0 30 300

Number of samples at time 6:

0 30 300

Number of samples at time 7:

0 30 300

Number of samples at time 8:

0 30 300

Number of samples at time 9:

0 30 300

Number of samples at time 10:

0 30 300

Number of samples at time 11:

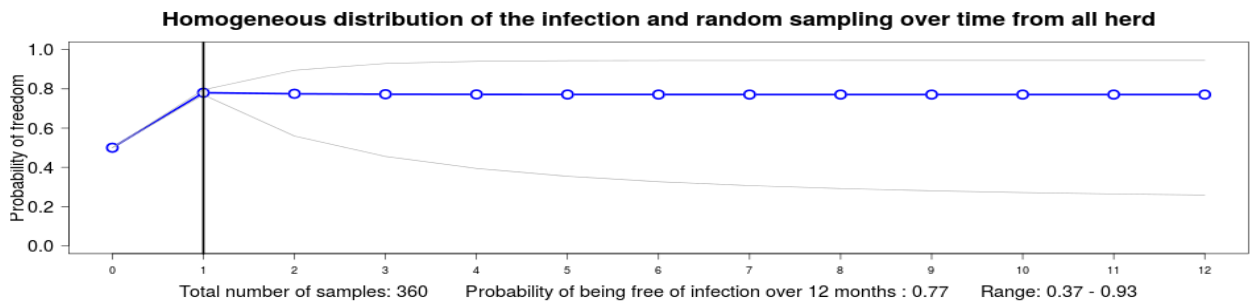
0 30 300

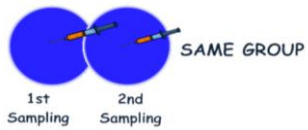
Number of samples at time 12:

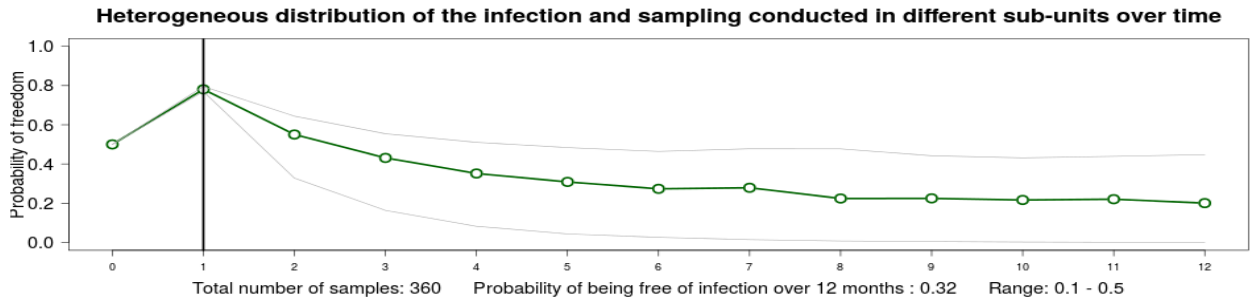
0 30 300

OUTCOMES

FREQUENCY OF SAMPLING:
MONTHLY
MAXIMUM NUMBER OF ANIMALS WOULD BE INFECTED:
150
TOTAL COST OF LABORATORY TESTING:
3600







$$AUC = \Delta\left(\frac{PFree_{t=1}}{2} + PFree_{t=2} + \ldots + \frac{PFree_{t=12}}{2}\right)$$

No guarantee of being free→ 0
Total confidence in being free of PRRS→ 1

Reflection

- Official regulations are standard and applicable to everyone, but the “best” (most efficient) surveillance strategy depends on the circumstances and varies across farms and systems
- Think about a pho recipe:

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The Secure Pork Supply is part of the Continuity of Business (COB) Planning that will be **<u>part of the state and federal response</u>** to FMD, ASF, or CSF.

- The COB plans all have a common goal
  - to facilitate agriculture and food industries in maintaining business operations, while also mitigating the risk of disease spread.
- The goal of Secure Pork Supply plan is
  - to avoid supply chain disruptions, mitigate interruptions in the movement of pork and pork products during an FMD, classical swine fever, African swine fever, or swine vesicular disease outbreak.

Secure Poultry Supply

FAD PReP
Foreign Animal Disease
Preparedness & Response Plan

USDA United States Department of Agriculture

The Foreign Animal Disease Preparedness and Response Plans

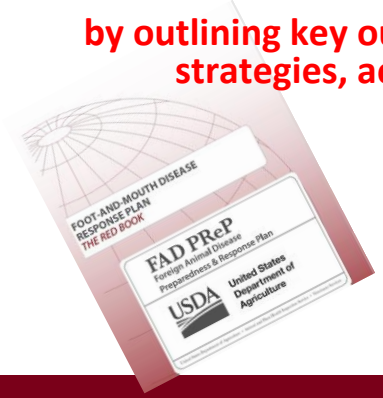
infected farms

guidance to responders at federal, state, and local levels

before, during, and after a foreign animal disease outbreak

to control and eradicate the foreign animal disease from the USA

by outlining key outbreak response strategies, activities and tools



The Secure Food Supply Plans for Poultry, Beef, Milk and Pork

SPS SECURE PORK SUPPLY
www.securepork.org

WHO	uninfected farms
WHAT	a proactive approach to move animals and products
WHEN	while in a control area during a foreign animal disease outbreak
WHY	to limit disease risk associated with specific movements
HOW	**by using risk-based science to construct risk mitigation strategies**

Secure Pork Supply Plan

(Funded by USDA APHIS VS and Pork Checkoff)

Provide a business continuity plan for pork premises that are **affected** by movement controls but not **infected** with FMD, CSF, or ASF

Voluntary

SPS Plan: Surveillance

Swine Health Monitors

- ✓ Caretakers trained recognize abnormal production parameters or clinical signs suggestive of ASF
- ✓ Look for these parameters and clinical signs on a daily basis

SPS Plan: Surveillance

- Sample collection and testing
- Observation by accredited veterinarian prior to loading animals onto trucks
- Daily observations and documentation by trained swine health monitors

What Are Key Elements of Continuity of Business Plans?

☑ **Biosecurity guidelines:**
Appropriate precautions, PPE, and specific steps for various fomites and equipment.
- SOME OF THE BIOSECURITY GUIDELINES CAN BE USED NOW **AND** WILL HELP PREPARE FOR A DISEASE OUTBREAK

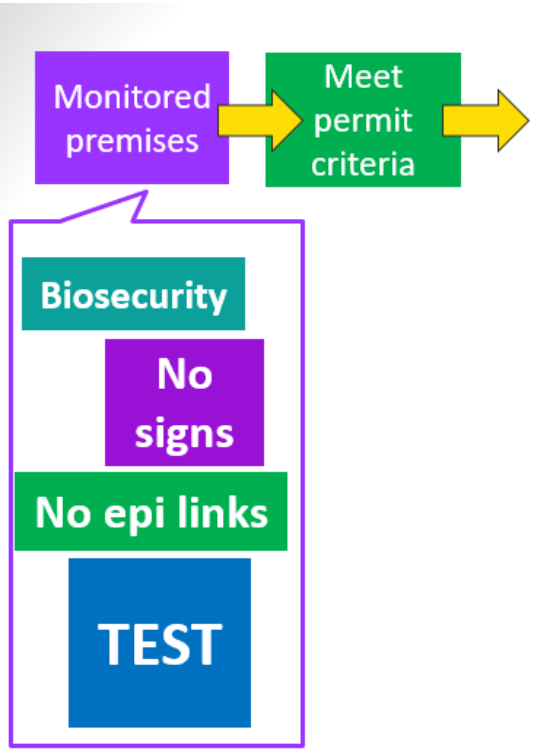
☑ **Cleaning and disinfection procedures:** requirements for various fomites and equipment, including information on appropriate disinfectants.
- SOME OF THE C&D PROCEDURES CAN BE USED NOW **AND** WILL HELP BE PREPARE FOR A DISEASE OUTBREAK

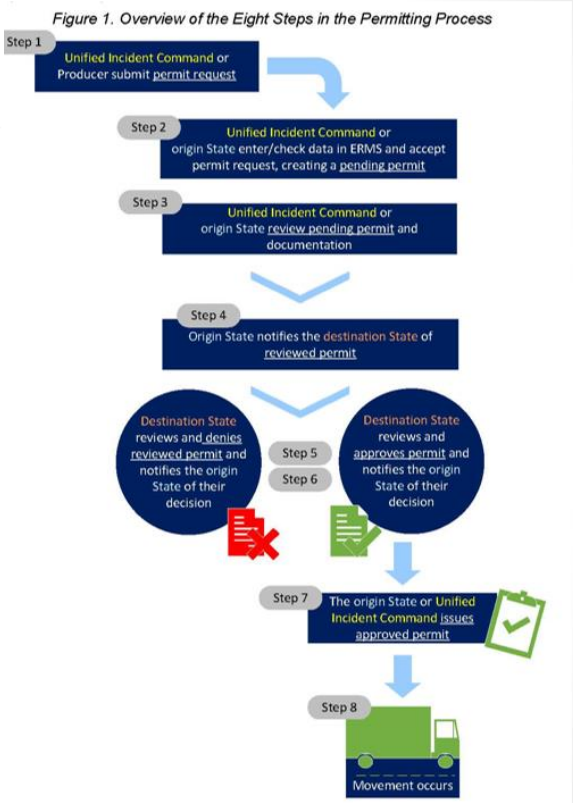
☑ **Epidemiological information:** routine and non-routine movements to and from premises, as well as information on the number of animals, species, and age of animals.
- THIS IS ONE OF THE REASONS WHY A VALIDATED PREMISES IDENTIFICATION NUMBER (PIN) IS NEEDED!

What Are Key Elements of Continuity of Business Plans?

Permitting guidance: Transparent, explicit guidance for state and federal government agencies that are part of the Incident Command regarding movement requirements for various commodities.

- ☐ *In progress*





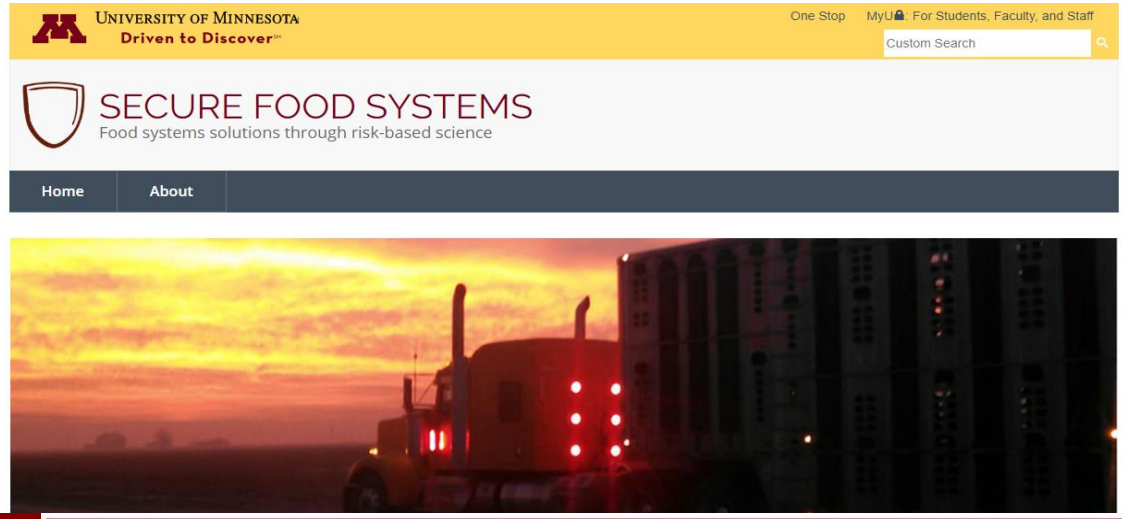
What Are Key Elements of Continuity of Business Plans?

- **Proactive Risk assessments:** help determine the disease transmission risk of specific movements.
- *more are needed!*

Risk assessments and tools

- RAs answer specific questions like:
  - What is the risk of moving product A from a farm in a control area?
- Based on current research in virology, epidemiology, and risk-assessment as well as agricultural industry practice.
- Tools can be used to help you gain more information about a situation.
- Neither tells you what to do.

All pork RAs and info sheet /fact sheets /visual guides permanently linked at: https://conservancy.umn.edu



Find the proactive risk assessments at:

http://securefoodsystems.umn.edu/

Minnesota's Secure Pork Supply

- MN SPS coordinator appointed Sept '17.
- Responsible for generating awareness, facilitating participation and offering feedback.
- "7 Steps to Participate" protocol developed
  - leads vets and producers through step-by-step process with www.securepork.org as guide.
- Biosecurity Checklist
  - https://www.bah.state.mn.us/secure-pork-supply-plan-checklist/
- Valid PINs

UNIVERSITY OF MINNESOTA EXTENSIO

Swine Extension

Educate yourself on foreign animal diseases

May 02, 2019

UMN Swine Extension has been working with Dave Wright, Secure Pork Supply coordinator with MN Board of Animal Health on spreading the word about Secure Pork Supply (SPS) Plan. The latest is four short videos to assist producers and veterinarians in identifying and preparing for a possible Foreign Animal Disease. The videos are intended to supplement materials found on the Secure Pork Supply website and focus on:

- Secure Pork Supply (SPS) Intro video (7:13 minutes)
- SPS - Foot and Mouth Disease video (5:21 minutes)
- SPS - Classical Swine Fever video (5:58 minutes)
- SPS - African Swine Fever video (12:19 minutes)

The videos can be viewed on the UMN Swine Extension YouTube Channel. They are also embedded in Step 7 of the "Seven Steps to Participate in Secure Pork Supply" found on the UMN Swine Extension blog. If you missed the SPS workshops that were held this fall/winter,

Reflection

- The ultimate objective of an on farm surveillance system should be to support the industry's business, preventing or mitigating the impact of ASF in our own farms and system, and also in our neighbors.

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Thank you!

Questions: aperez@umn.edu