# Foot And Mouth Disease:
## Testing Strategies for outbreak Surveillance

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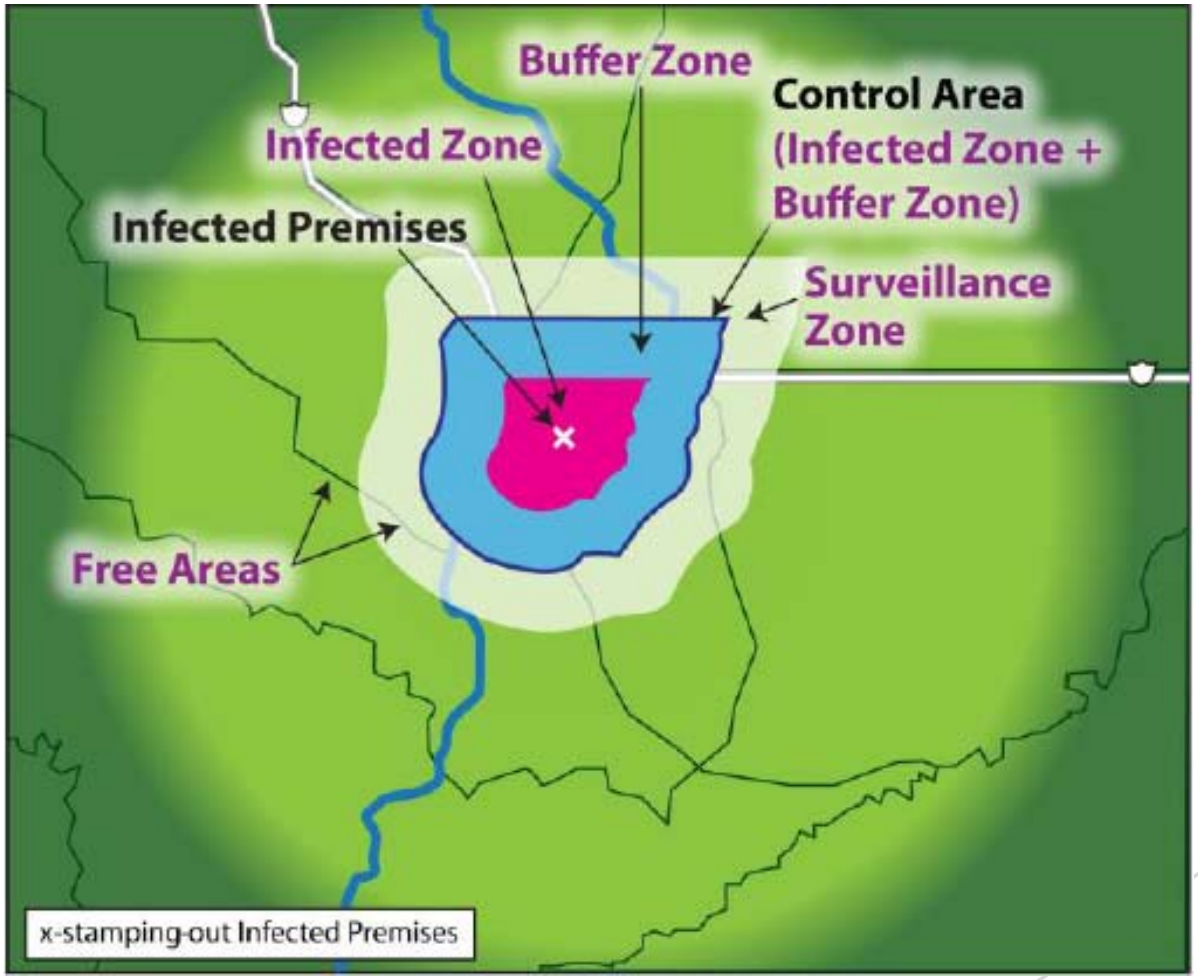
# Outline

- Overview of U.S. FMD outbreak response plans
  - Zoning
  - Current testing methodologies
  - Outbreak testing
- New testing strategies
  - Overview of potential future tests
  - Bulk tank milk test
  - Oral fluid test
  - Air sampling

# U.S. FMD outbreak response: Zoning



# Testing methodologies: FAD Investigation

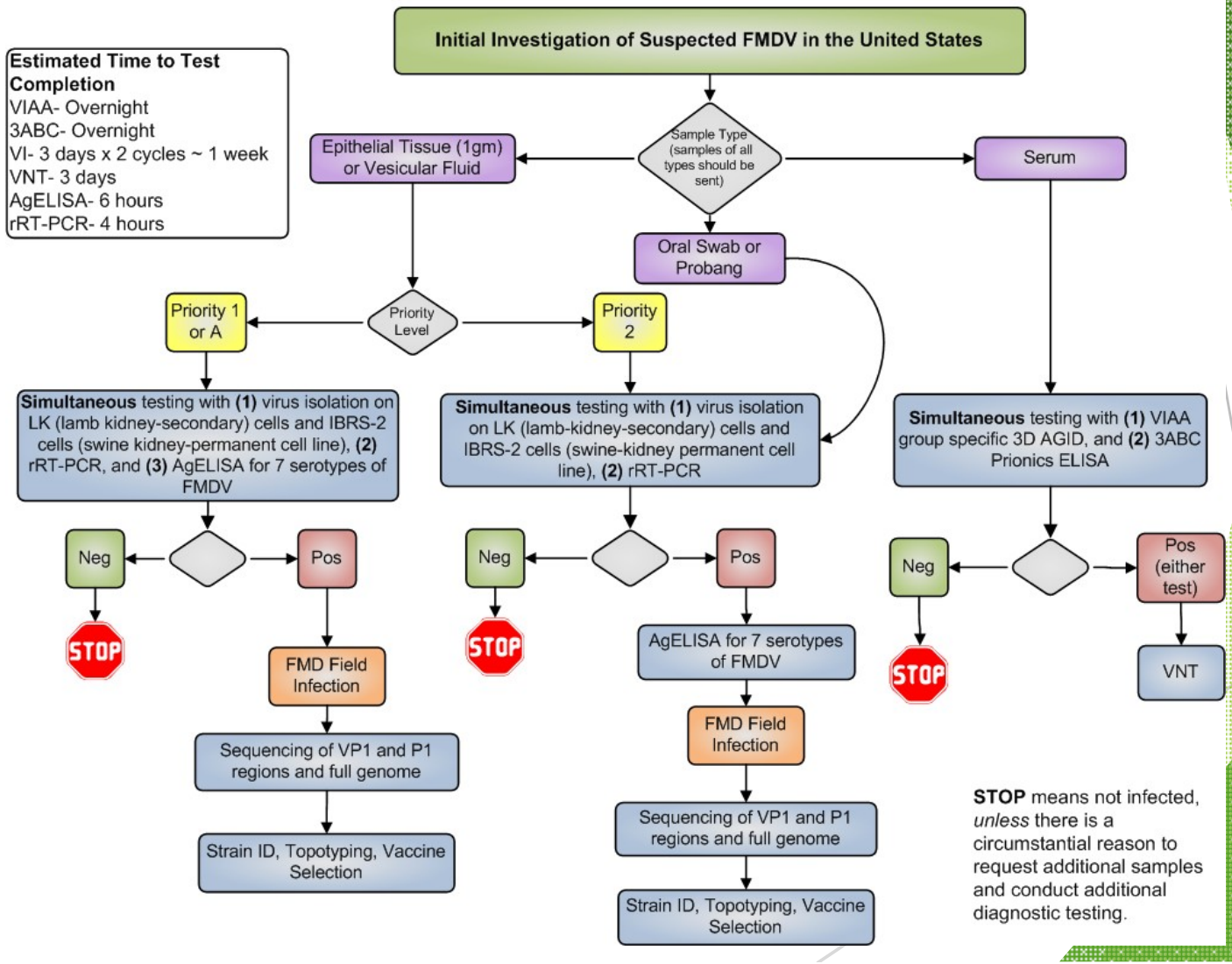
Primary tests

- Real-time reverse transcriptase polymerase chain reaction (rRT-PCR)
  - Serum, vesicular tissue/fluid, oral or nasal swab samples
  - High specificity
- 3ABC enzyme-linked immunosorbent assay (3 ABC ELISA)
  - Serum samples
  - DIVA
- Virus Isolation (VI)
  - Run for all samples, longer turnaround time
  - Gold standard for detection

# Testing methodologies: FAD Investigation

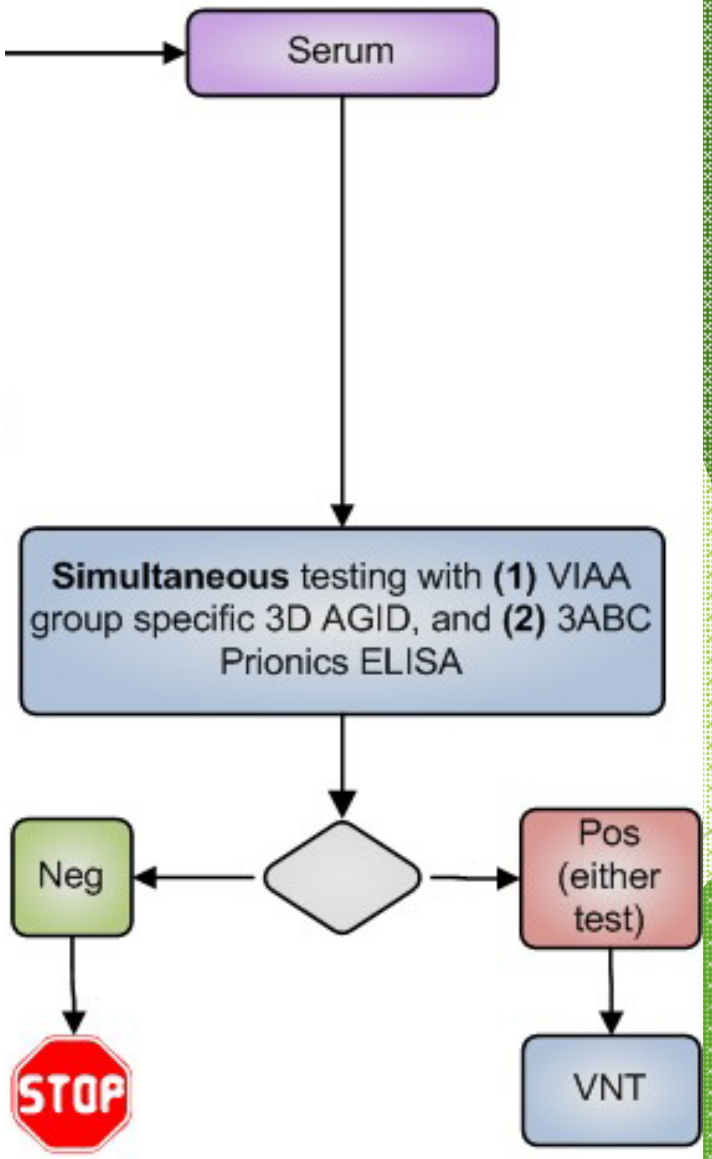
- Virus infection association antigen (VIAA) group specific 3D agarose immunodiffusion (AGID)
  - Lower sensitivity than ELISA
  - Timing
- Antigen ELISA (AgELISA)
  - Requires select agents for testing
  - Poor scalability to NAHLN
  - Serotype specific
- Commonality amongst all these tests?

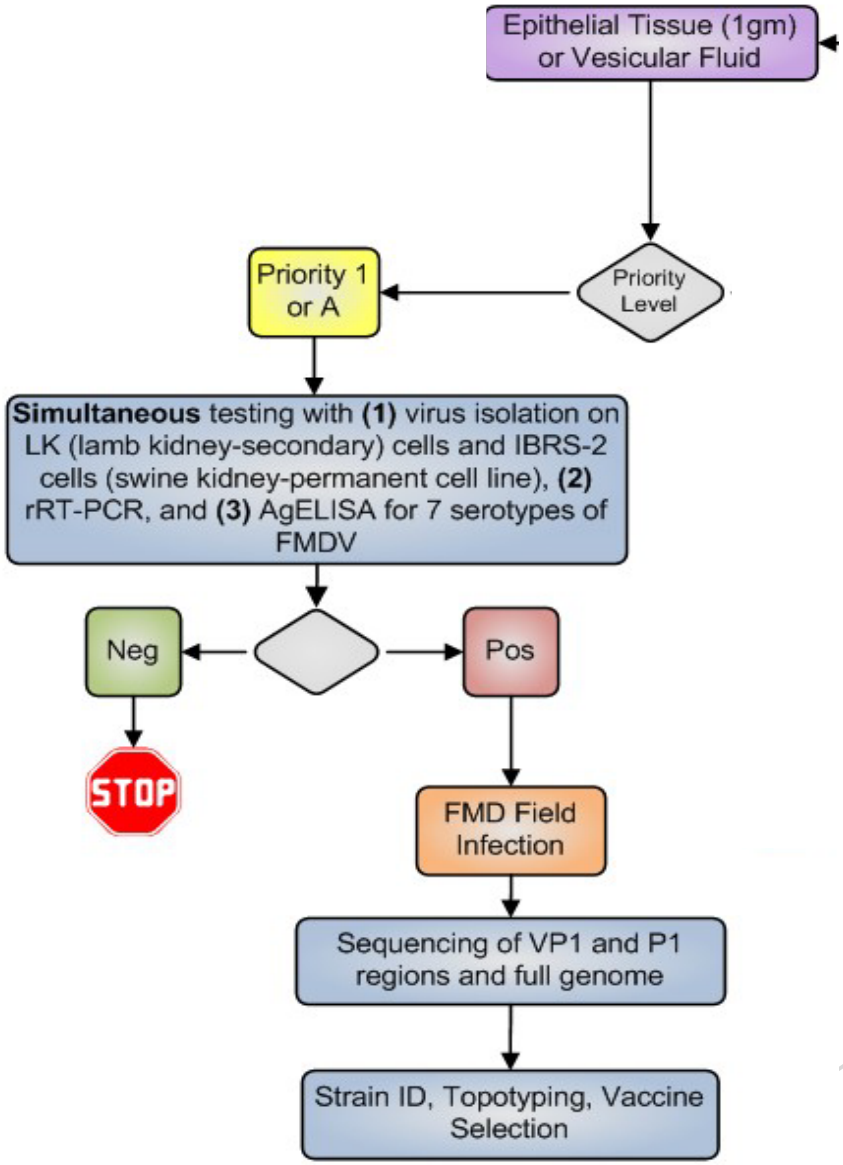
## *Figure 5-2. Diagnostic Flowchart for Initial Investigation of FMD*



**Estimated Time to Test Completion**

VIAA- Overnight
3ABC- Overnight
VI- 3 days x 2 cycles ~ 1 week
VNT- 3 days
AgELISA- 6 hours
rRT-PCR- 4 hours

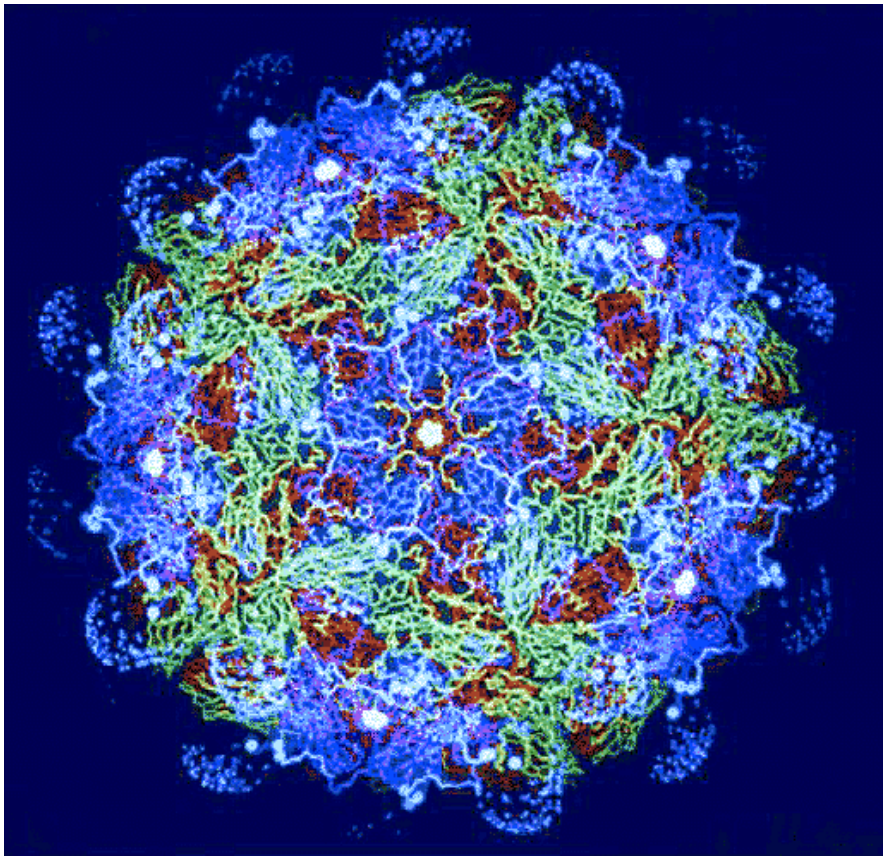



Epithelial Tissue (1gm) or Vesicular Fluid
Priority Level
Priority 1 or A
Simultaneous testing with (1) virus isolation on LK (lamb kidney-secondary) cells and IBRS-2 cells (swine kidney-permanent cell line), (2) rRT-PCR, and (3) AgELISA for 7 serotypes of FMDV
Neg
Pos
STOP
FMD Field Infection
Sequencing of VP1 and P1 regions and full genome
Strain ID, Topotyping, Vaccine Selection

# Outbreak testing

- FADDL would diagnose new outbreak areas
- NAHLN labs would perform PCR testing from known infected premises
- Business continuity plans?
  - Biosecurity measures
  - Active observational surveillance
  - Serum/whole blood PCR testing
  - Environmental sampling (theoretical)

# Post-outbreak testing: Serology



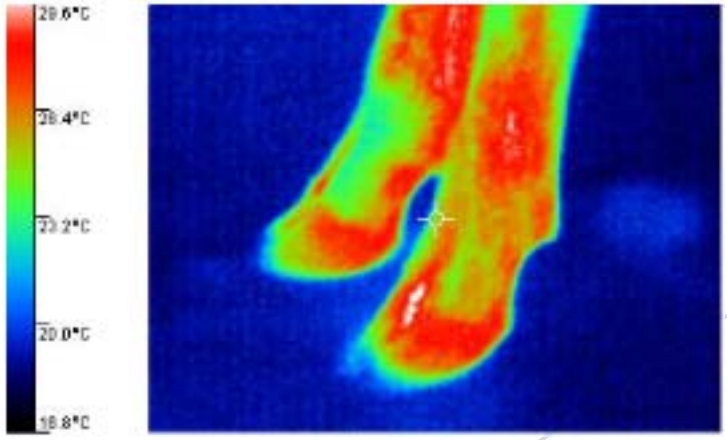
- 3ABC ELISA test
  - DIVA compatible
- Virus Neutralization (VNT)
  - Used to strain type
  - Time consuming
  - Labor intensive
  - Demonstrate freedom

# On the horizon…

- Individual animal testing
  - Lateral flow device
  - Portable molecular assays
  - Molecular genome sequencing
  - ELISA kits for other non-structural proteins
- Environmental
  - Air sampling
  - Thermography
- Aggregate testing
  - Oral fluid evaluation
  - Bulk milk tank testing



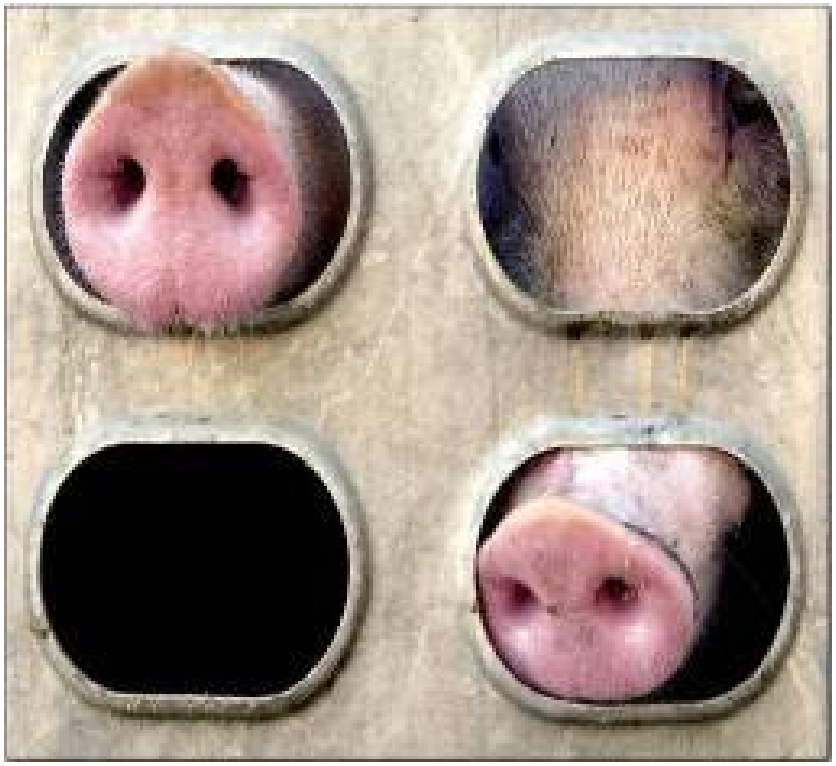
Smiths Bio-Seeq™



# Oral fluid sampling

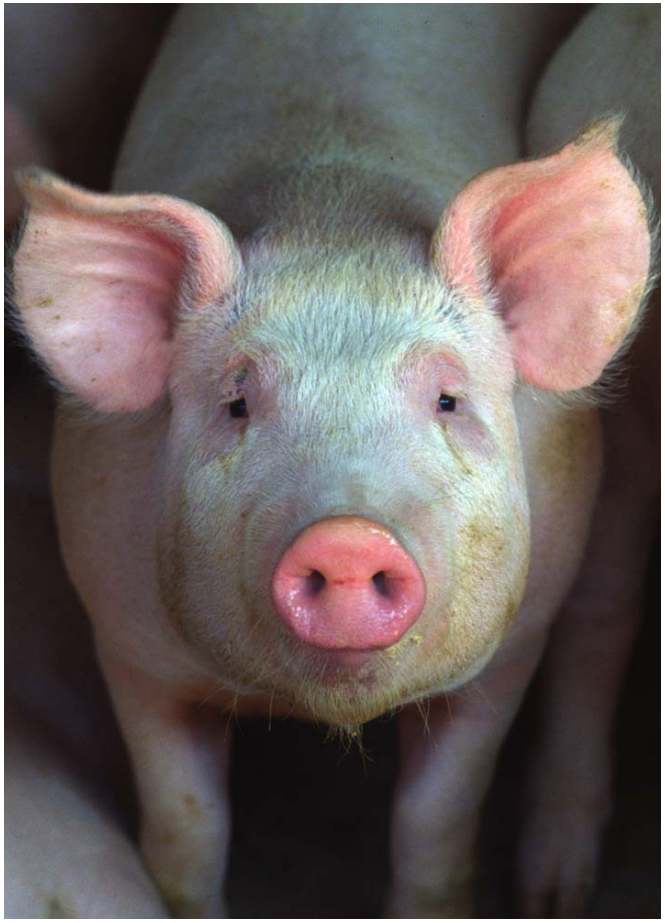
- Composite sample
- Endemic disease surveillance
- Industry support
- Viral shedding in oral fluids

# Oral fluid sampling



- Advantages
  - Prioritize resources
  - Aggregate testing
  - Ease of sampling
  - Monitor for multiple diseases
- Limitations
  - Pathogen shedding in oral fluids
  - Sample dilution/contamination
  - Test validation

# Potential applications: oral fluid sampling



- Early detection of foreign animal diseases?
- Finisher swine movement to slaughter?
- Foreign animal disease outbreak surveillance?
- Endemic disease surveillance?

# Bulk tank milk testing

- Virus shedding prior to clinical signs
- rRT-PCR assay detects viral RNA
  - Reported sensitivity = 86.4%
  - Reported specificity = 100%
- Advantages
  - Sample turn around time
  - Aggregate test
  - Easily collected samples
- Disadvantages
  - Laboratory scalability
  - Timeliness

# Bulk tank milk testing

- Potential applications
  - Testing premises within a control area
  - Confirmation of infection
  - Monitoring premises outside of control area
  - Screening of infected dairy premises
  - Targeted surveillance

# Bulk tank milk testing

- Limitations
  - Movement permitting during an outbreak
  - Maintaining disease freedom status
  - Early detection of an outbreak
  - Using in FAD investigations

# Air sampling

- Virus shed prior to clinical signs
- rRT-PCR assay detects viral RNA
- Advantages
  - Aggregate test
  - Easily collected samples
  - High detection limit
- Disadvantages
  - Applicability to different production systems
  - Filter change frequency

# Air sampling

- Potential applications
  - Testing premises within a control area
  - Monitoring premises outside of control area
  - Screening dairy premises
  - Targeted surveillance

# Questions/Discussion