Tips, tricks, and wishes from a diagnostician perspective

Marcelo Almeida, DVM, MS, PhD, Eric Burrough, DVM, PhD, DACVP, Kent Schwartz, DVM, MS

Iowa State University Veterinary Diagnostic Laboratory
Department of Veterinary Diagnostic and Production Animal Medicine
College of Veterinary Medicine

Leman China Swine Conference 2024, Chengdu, China

IOWA STATE UNIVERSITY

It would be nice to have a subtitle

More isn't always better: the role of individual animal disease diagnostics in a big data world


EXIT

Age

Number of Animals Sampled 4

CLINICAL SIGNS/SYNDROME

☑ CNS	☑ Enteric	☑ Lameness	☐ Reproductive
☑ Respiratory	☑ Sudden Death	☑ Systemic	☐

CLINICAL SIGNS, TREATMENT & RESPONSE, FEEDING, POST MORTEM FINDINGS, DIFFERENTIAL DIAGNOSIS

At risk _____ # or % Sick _____ # or % Dead _____

Which pig = which syndrome?

122 tissues counted = 30+ slides (4 tissues/slide) = $245+ in histology alone

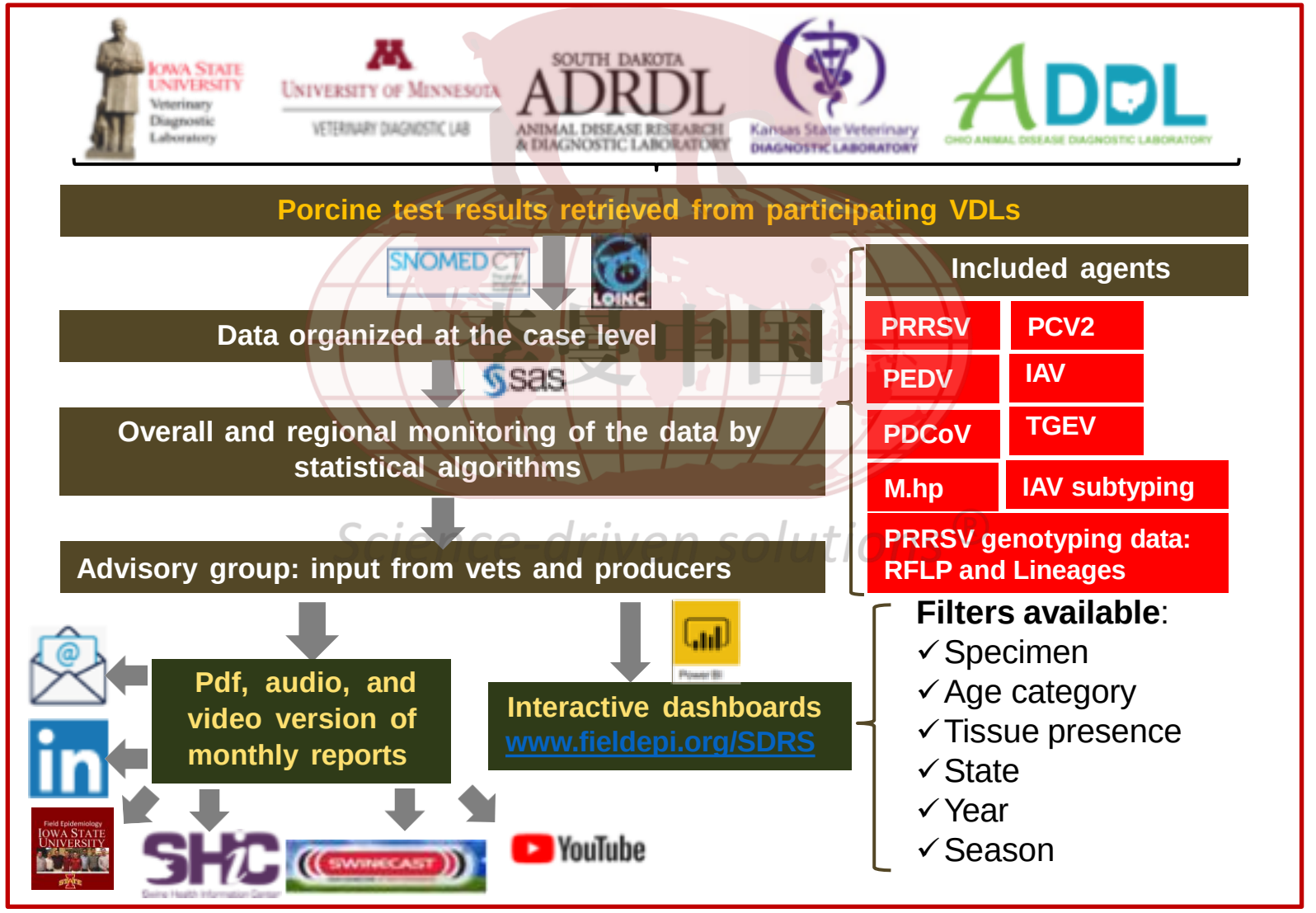
Burrough. ISUVDL.

What is big data?

Big data is a term that describes large, hard-to-manage volumes of data – both structured and unstructured – that inundate businesses on a day-to-day basis.

SAS

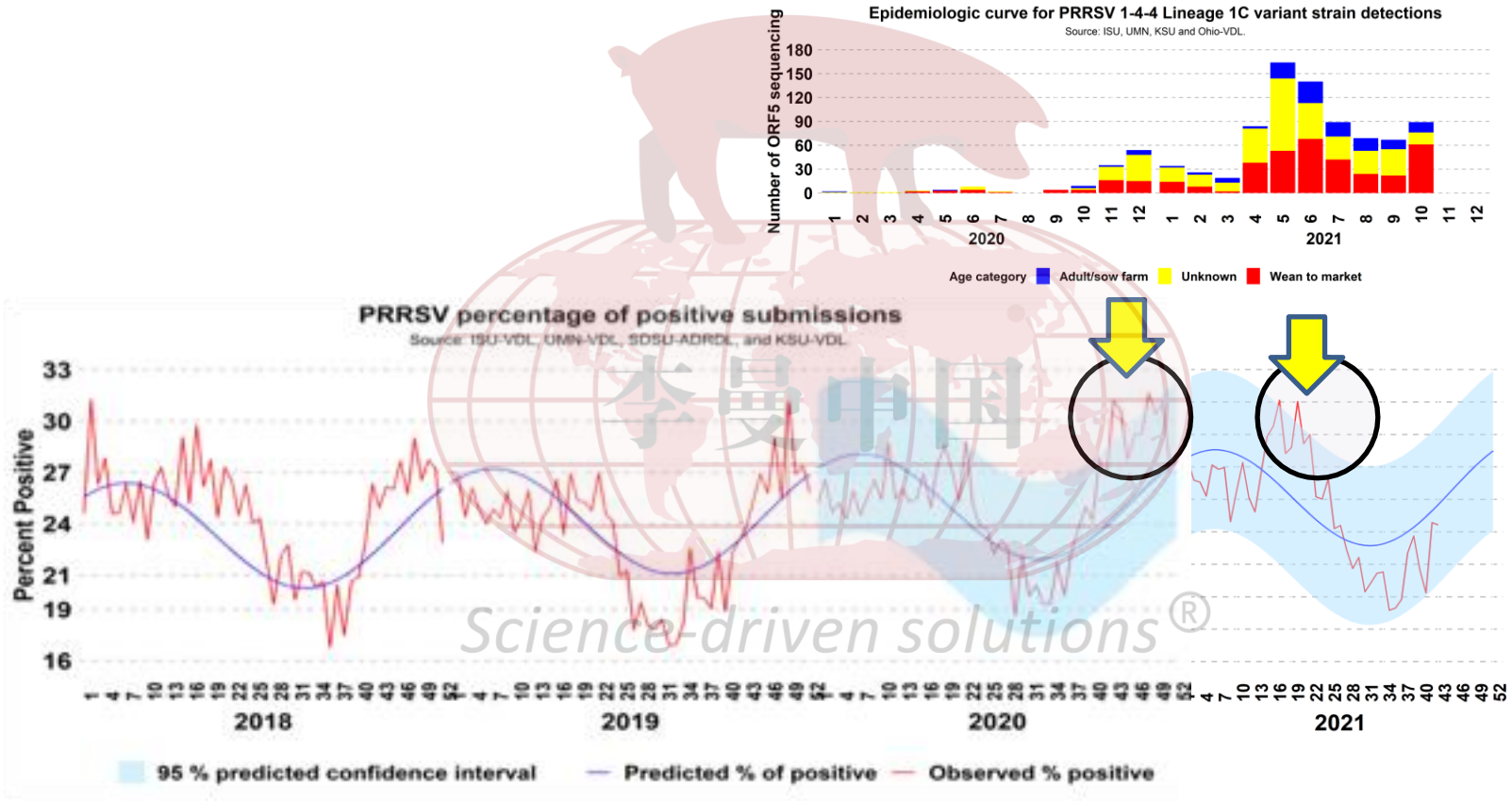
SDRS: collaborative project across VDLs & swine industry



Trevisan *et al.*

Swine Disease Reporting System https://www.fieldepi.org/SDRS

Proactive monitoring of PCR data was key to detecting the emergence of a new PRRSV strain



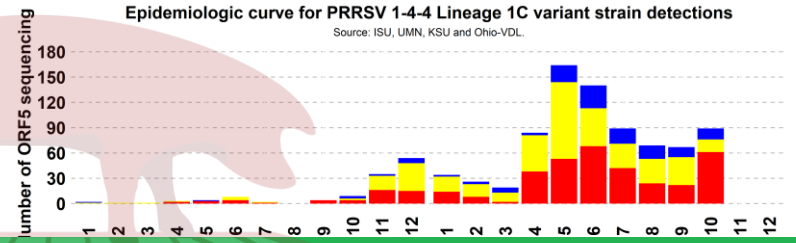
Abnormal drop in Ct values to historical lowest levels.

More requests for PRRSV ORF5 sequencing.

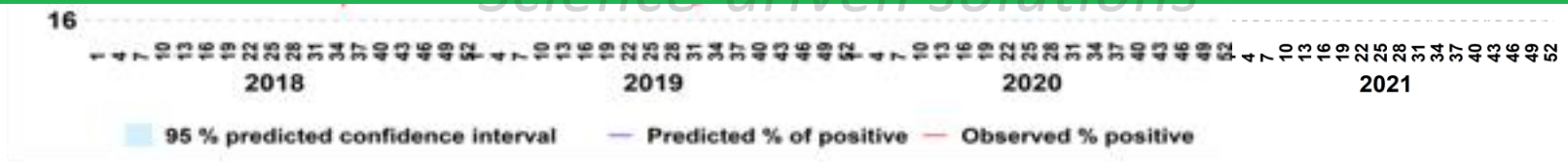
New PRRSV strain:
PRRS 1-4-4 L1C variant

Swine Disease Reporting System https://www.fieldepi.org/SDRS

Proactive monitoring of PCR data was key to detecting the emergence of a new PRRSV strain



What are the sources of bias or pitfalls that are inherent to the data? How do those affect interpretation? What are the pitfalls?

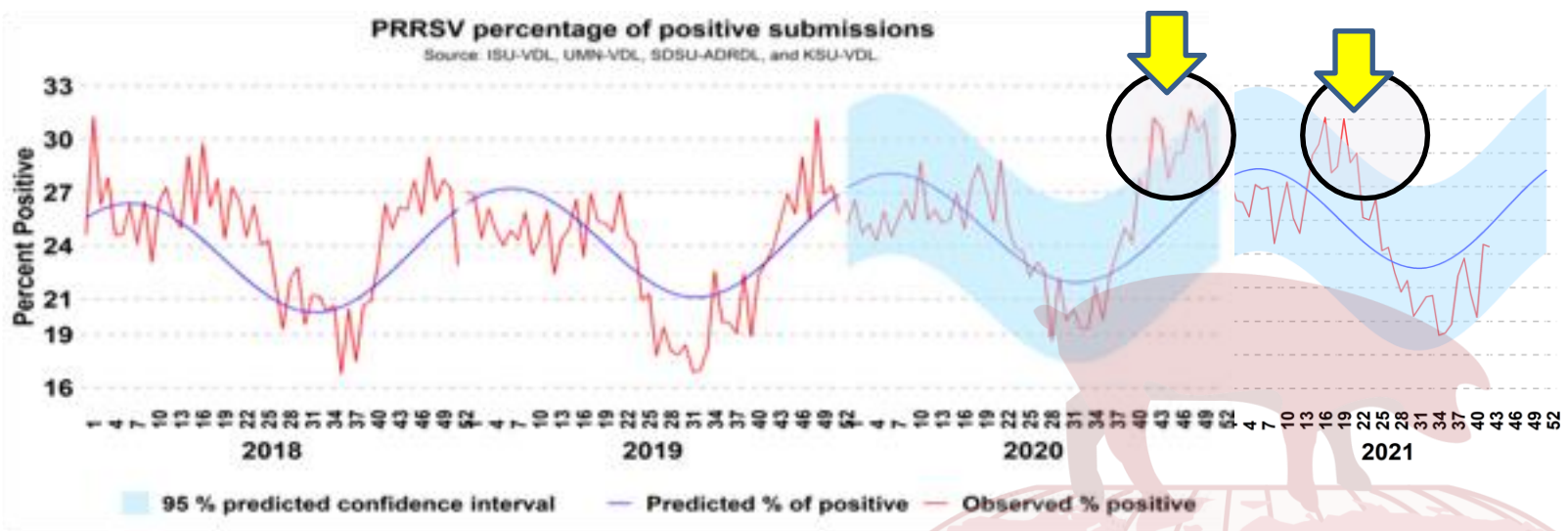


Abnormal drop in Ct values to historical lowest levels.

More requests for PRRSV ORF5 sequencing.

New PRRSV strain:
PRRS 1-4-4 L1C variant

Swine Disease Reporting System https://www.fieldepi.org/SDRS



What does PRRSV detection by PCR look like over time?

Is it behaving as expected

Is the PCR behaving adequately?

PCR variability across labs
Sensitivity improvement over time

What does the data look like excluding high health herds?

How does testing and retesting affect the analysis?

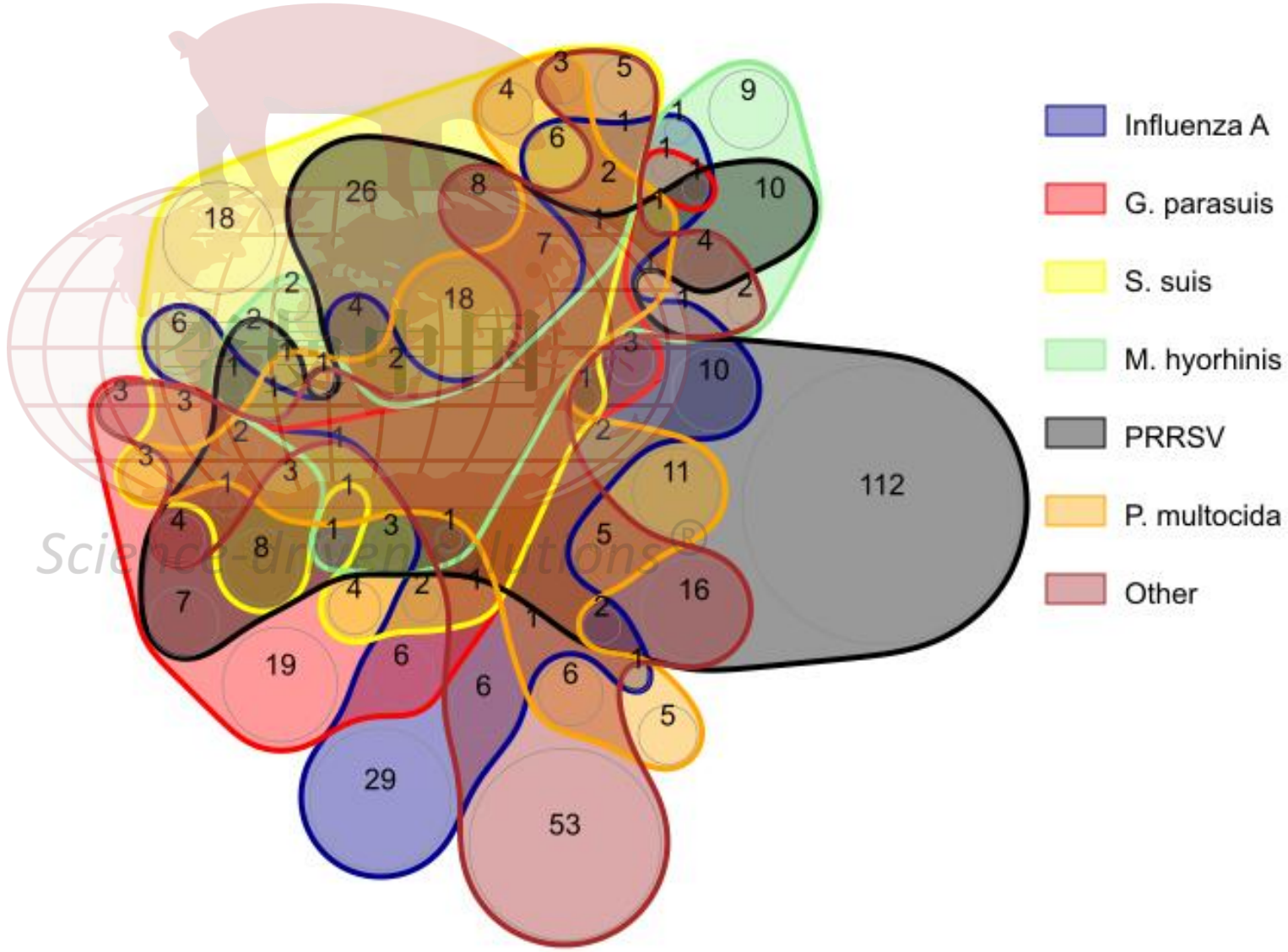
How about vaccine vs wild-type detection?

Shifts in vaccination, control and elimination practices

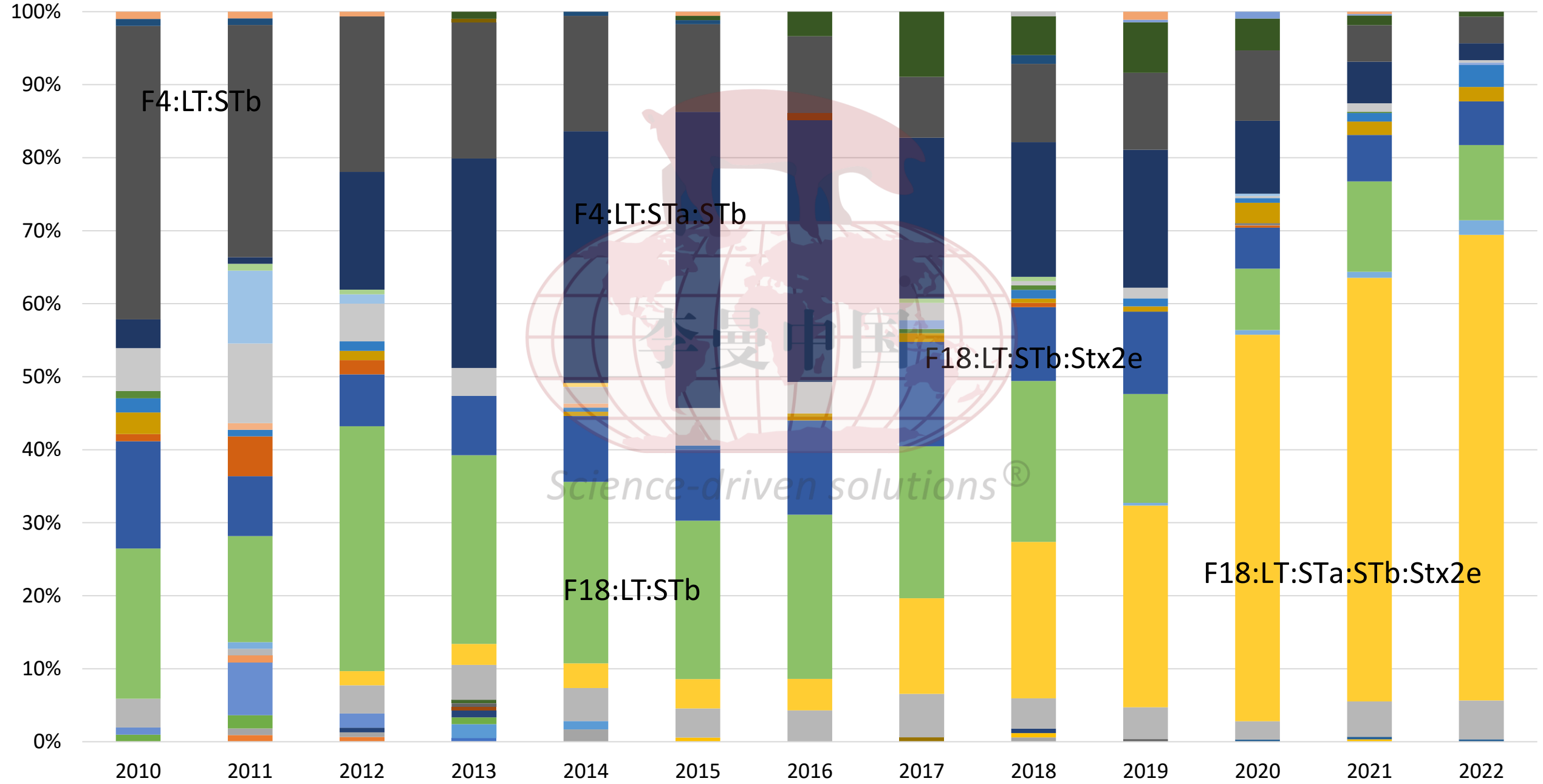
How about the recombination events?

Small pieces make the big picture

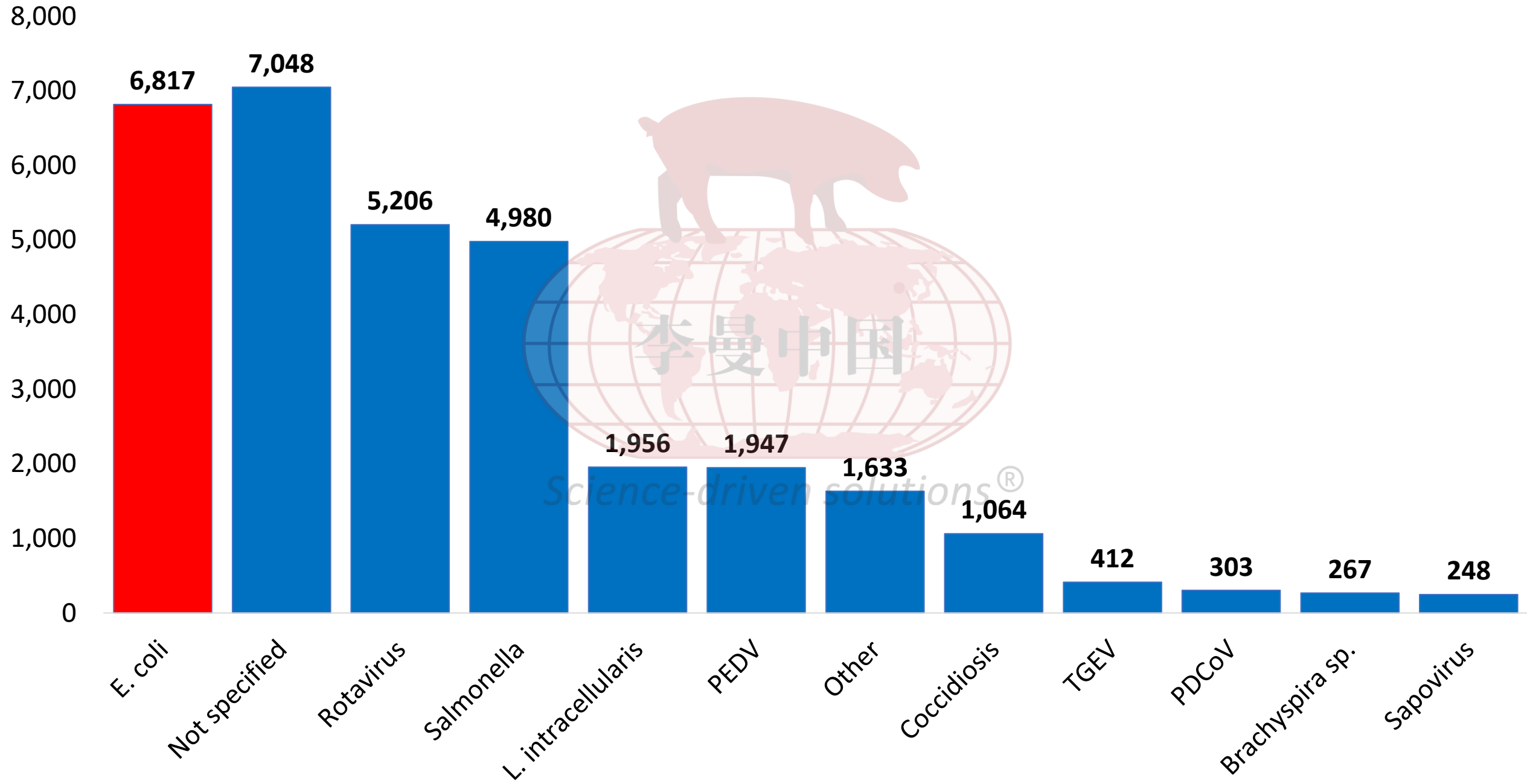
- How do you get DxCodes



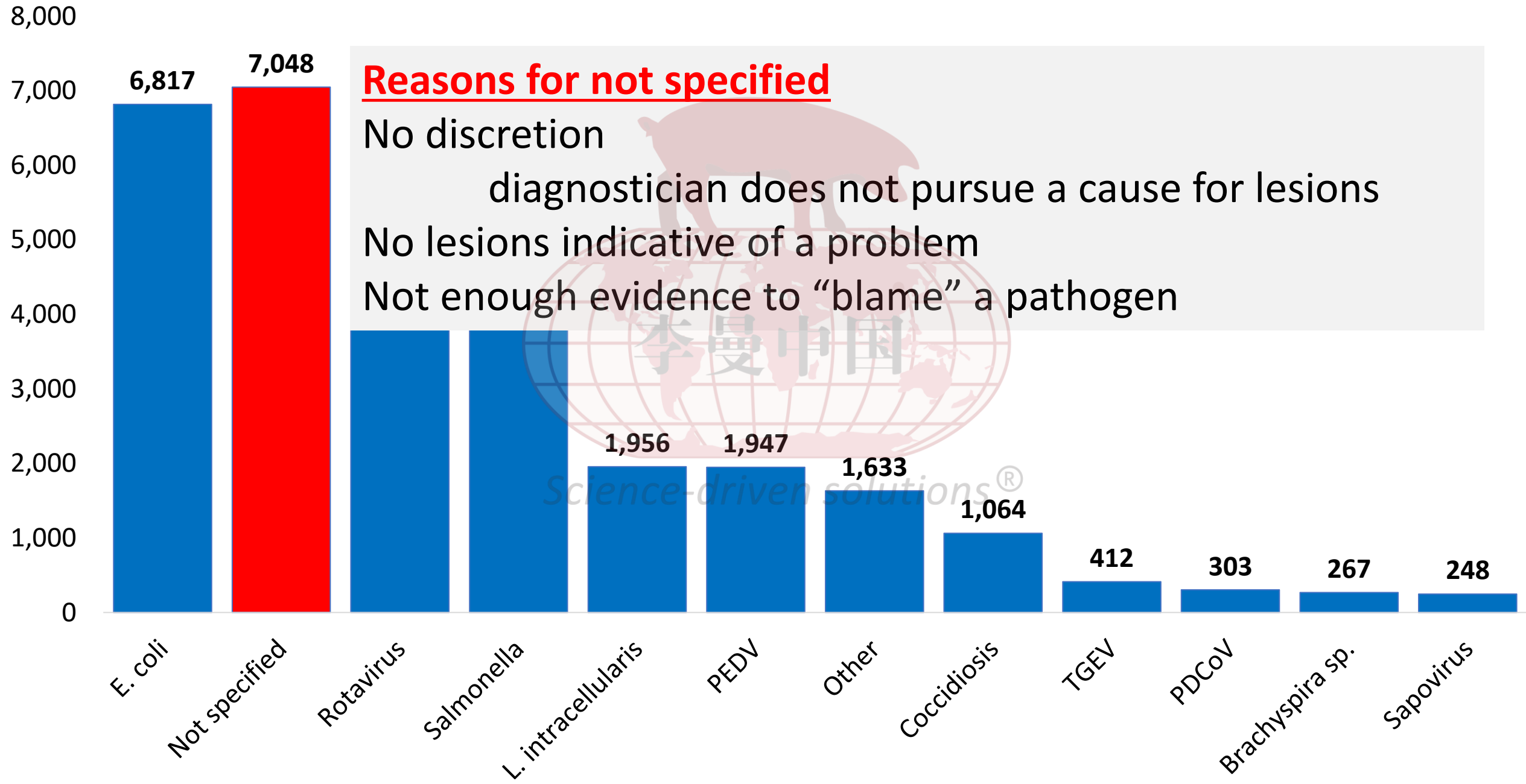
E. coli virotypes in cases diagnosed at the ISU VDL 2010-2022



Causes of post weaning diarrhea diagnosed at the ISU VDL from 2007 - 2023



Causes of post weaning diarrhea diagnosed at the ISU VDL from 2007 - 2023



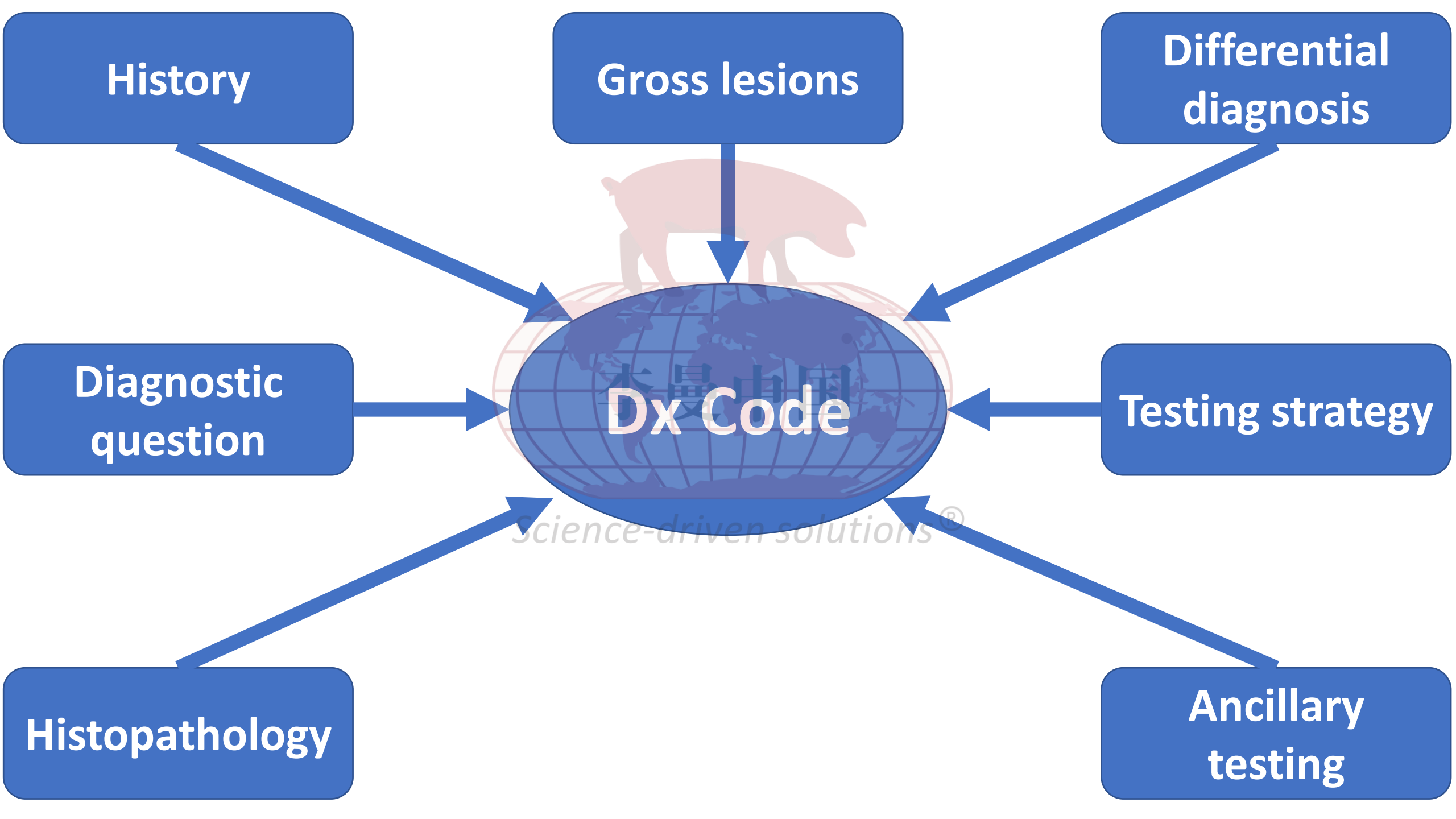
Reasons for not specified

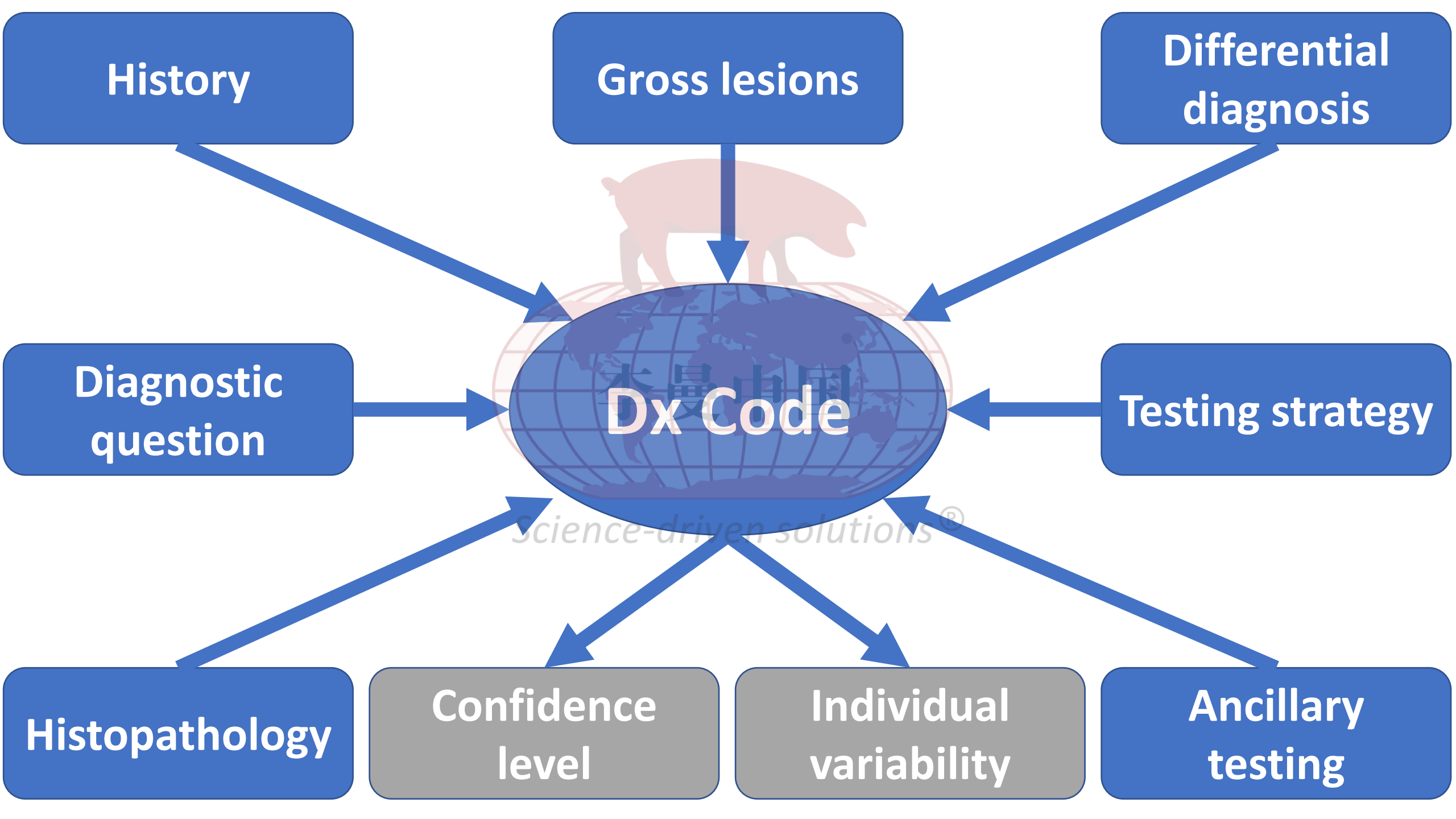
No discretion

diagnostician does not pursue a cause for lesions

No lesions indicative of a problem

Not enough evidence to "blame" a pathogen


History
Gross lesions
Differential diagnosis
Diagnostic question
Dx Code
Testing strategy
Histopathology
Ancillary testing
Science-driven solutions®


History
Gross lesions
Differential diagnosis
Diagnostic question
Dx Code
Testing strategy
Histopathology
Confidence level
Individual variability
Ancillary testing

Interpreting diagnostic data

"Absolute certainty in diagnosis is unattainable, no matter how much information we gather, how many observations we make, or how many tests we perform."

Our Stubborn Quest for Diagnostic Certainty
Jerome P. Kassirer, M.D.
N Engl J Med 1989; 320:1489-1491June 1, 1989DOI: 10.1056/NEJM198906013202211

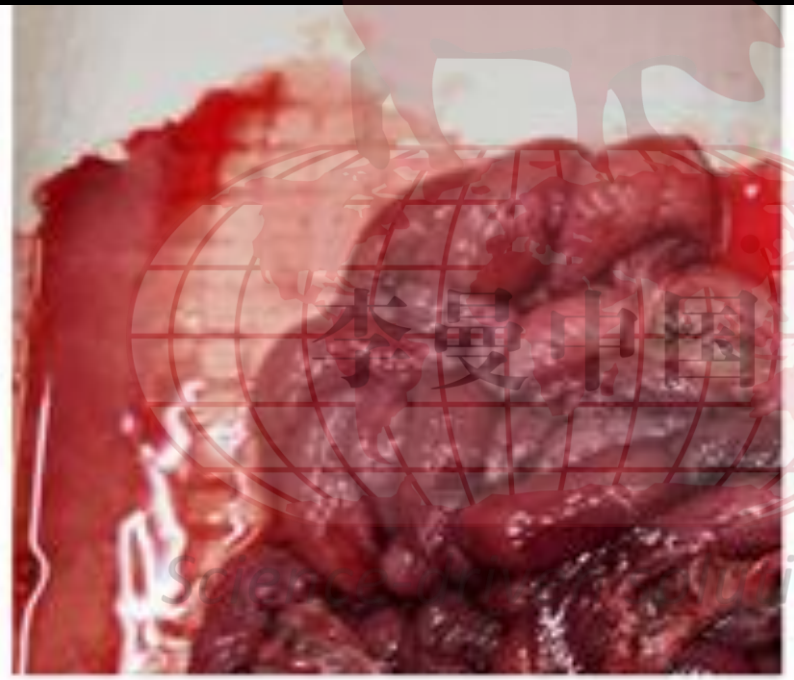
Interpreting diagnostic data

"Absolute certainty in diagnosis is unattainable, no matter how much information we gather, how many observations we make, or how many tests we perform."

"Our task is not to attain certainty, but rather to reduce the level of diagnostic uncertainty enough to make optimal therapeutic decisions."

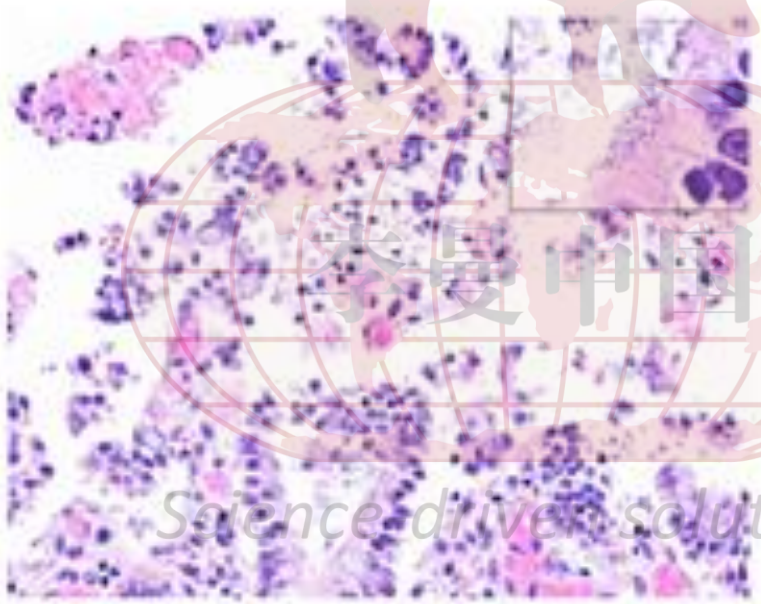
Our Stubborn Quest for Diagnostic Certainty
Jerome P. Kassirer, M.D.
N Engl J Med 1989; 320:1489-1491June 1, 1989DOI: 10.1056/NEJM198906013202211

Gross: flaccid congested GI with watery serosanguineous contents



pH strip immediately slams into green: secretory diarrhea

Histo: heavy colibacillary colonization with microvascular thrombosis



Genotyping:
hybrid
ETEC/STEC

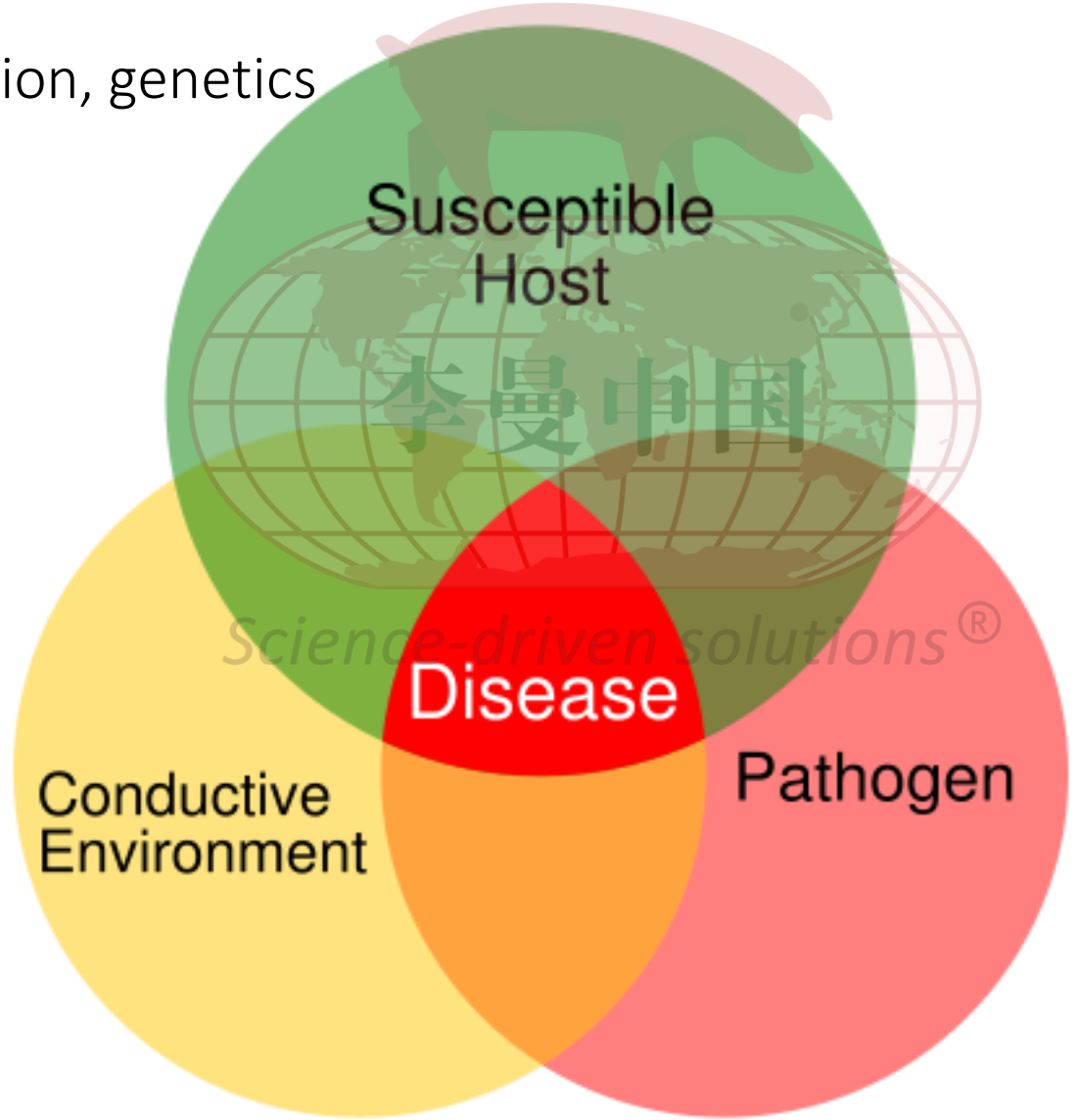
Gene
EAST1 (toxin)
LT(toxin)
STa(toxin)
STb(toxin)
Stx1 (toxin)
Stx2 (toxin)
Stx2e(toxin)
F18(pilus)

The small pieces are also complex

- Health challenges in pigs often present significant diagnostic dilemmas:
  - Many common pathogens are endemic on affected farms
    - Detection may or may not = disease
  - Available diagnostic tests may not readily differentiate pathogens from non-pathogens and/or vaccines
  - Disease expression is variable within and among farms
    - On-farm management factors impact disease expression
  - Mixed infections are common (if not the norm)

Many swine “pathogens” are ENDEMIC opportunists

immunity, nutrition, genetics



facilities, temp, management

Dose x Virulence

The Diagnostic Process

For diagnostic investigations, finding the “right” answer begins with two fundamental concepts:

1. Well-defined diagnostic question(s)
   - Formulated in context to the specific issue at hand

2. Proper sampling to address these specific question(s)
   - More is not always better, particularly if #1 is ill-defined

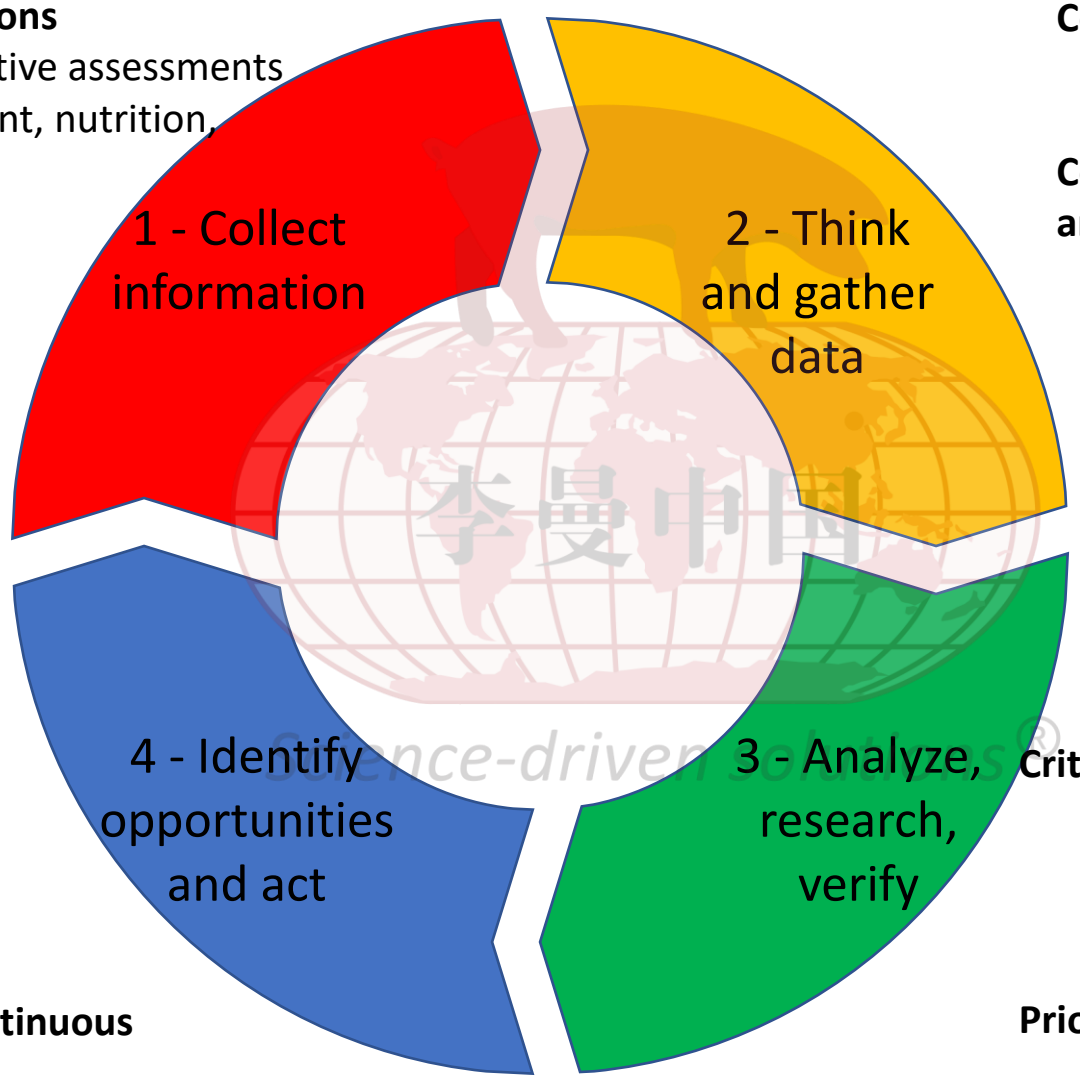
Relevant history and records

Primary complaint, historical issues, treatment process

Clinical observations and gross lesions

Subjective/objective/quantitative assessments

Assess risk factors: Environment, nutrition, commingling, etc



Create case definition/prioritize a realistic differential diagnosis

Formed with current clinical context

Consider laboratory testing

Define specific diagnostic questions that testing can answer

Collect appropriate samples from proper animals (critical step)

Critically analyze diagnostic data

Do the results align (“make sense”) with expectations?

If not alignment, reiterate process until results make sense

Prioritize detected agents and risk factors

Proximate cause(s) versus ultimate cause(s)

Verify with histopathology when possible

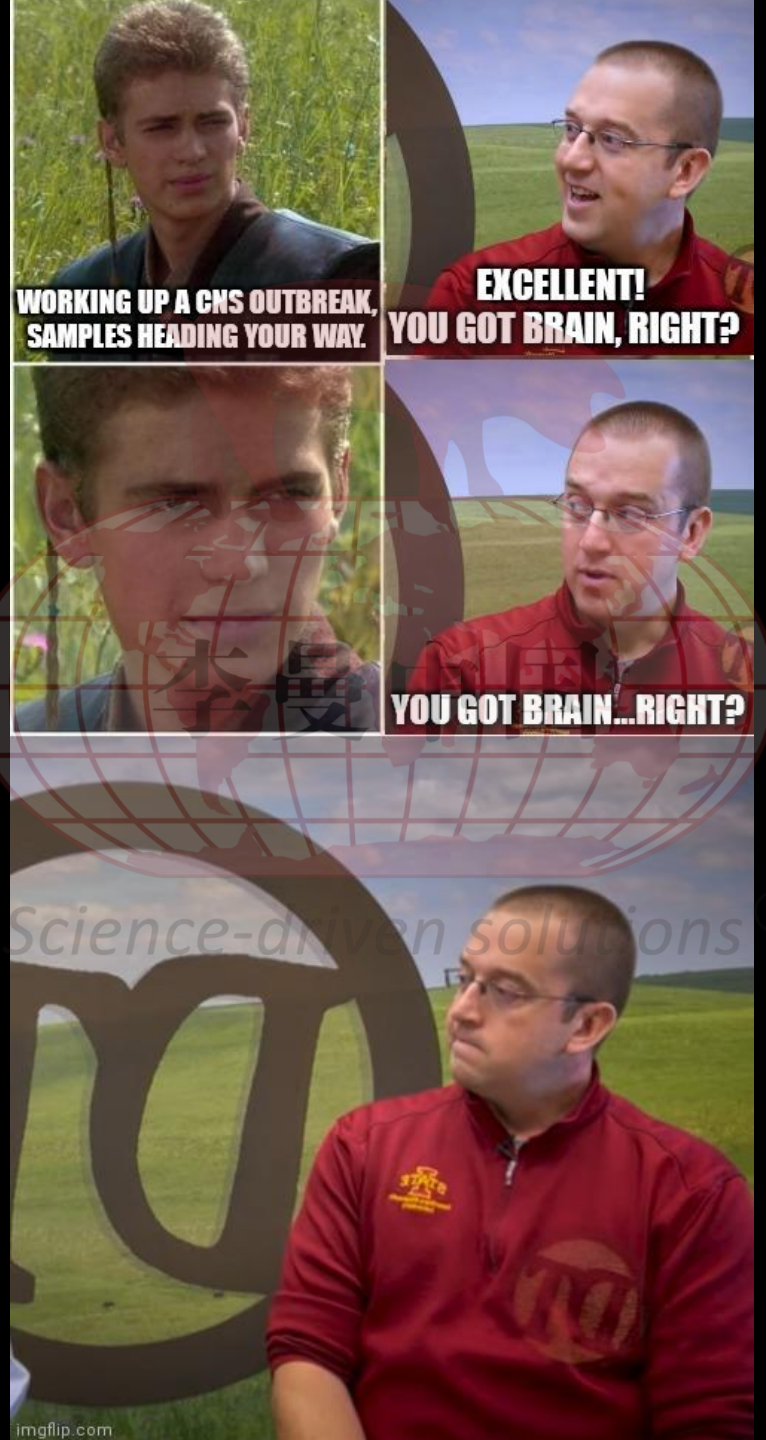
Establish a diagnosis and risk factors relevant to case definition

Interventions, monitoring, and continuous improvement

Treatment, control, prevention, elimination, etc.

Monitor and refine or identify options for continuous improvement


WELCOME TO HEAVEN! ENTER HERE!
Well crap!
©nakedpastor


WORKING UP A CNS OUTBREAK, SAMPLES HEADING YOUR WAY.
EXCELLENT! YOU GOT BRAIN, RIGHT?
YOU GOT BRAIN...RIGHT?
imgflip.com

Context matters

- A concise history is important
- How many pigs are at risk, sick, or have died?
- Acute vs chronic presentation
- Treated vs non treated
- Euthanized vs found dead
- Which pigs had the clinical signs or lesions described?
  - Did this one pig have CNS, respiratory, systemic, digestive, and sudden death?

Wishes and tips

- Complete short history
- Gross lesions
- Diagnostic question
- Clinical signs and lesions specific to pigs submitted
- Discretion to downsize testing
- Things to teach staff
  - Chop off heads or send brains and legs, or spinal cord in special cases
  - Intestinal anatomy (duodenum, jejunum, ileum, colon)
  - Open stomachs (ulcers) and hearts (VVE or MHD)
- Ask your diagnostician about follow-up testing (serotyping, genotyping, WGS, NGS)

Final remarks

- Every submission opens a dialog between clinician and diagnostician
- Most communication happens in written form
- Calls are appreciated and encouraged (before, during, and after)
- Accuracy and quality are dependent on initial input

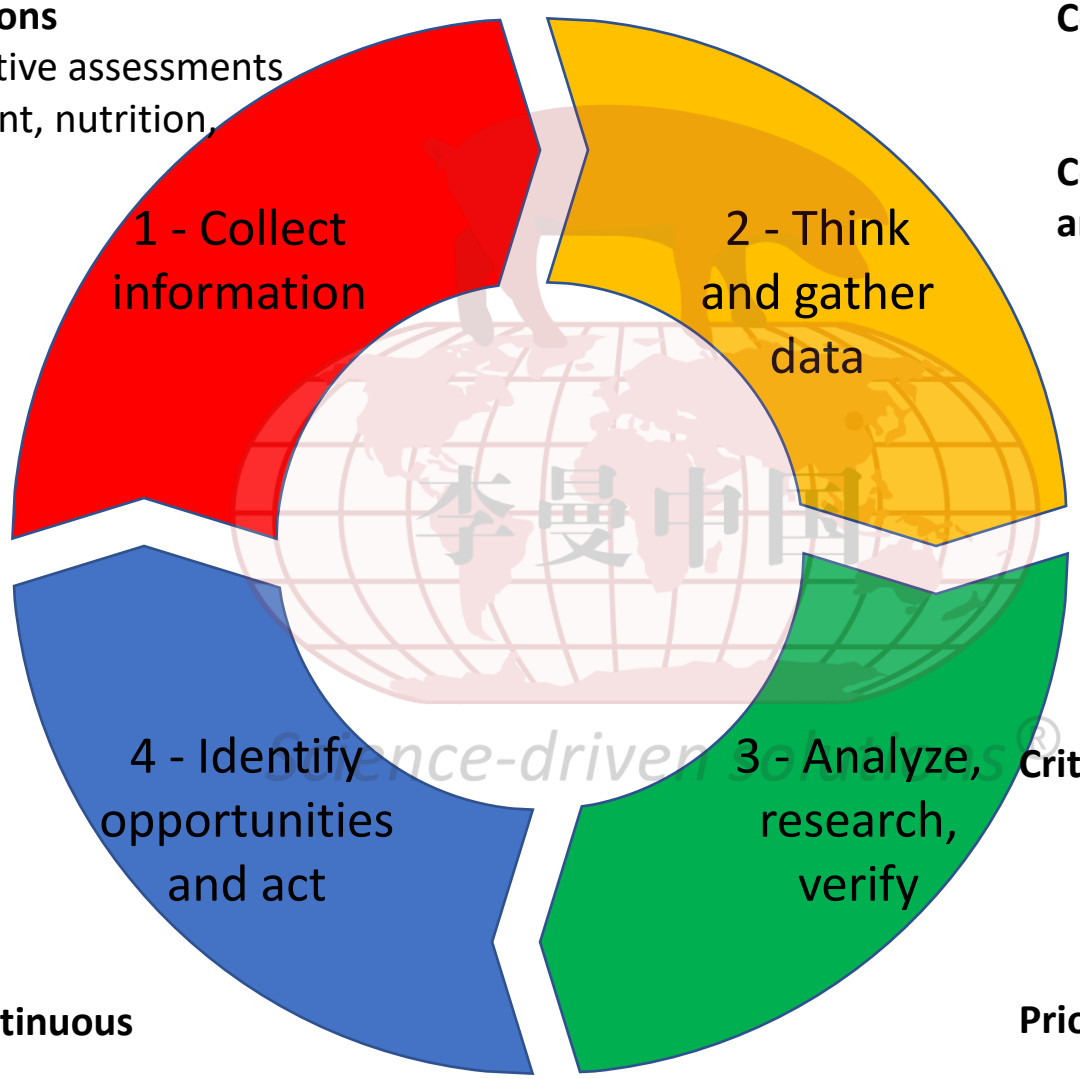
Relevant history and records

Primary complaint, historical issues, treatment process

Clinical observations and gross lesions

Subjective/objective/quantitative assessments

Assess risk factors: Environment, nutrition, commingling, etc



Create case definition/prioritize a realistic differential diagnosis

Formed with current clinical context

Consider laboratory testing

Define specific diagnostic questions that testing can answer

Collect appropriate samples from proper animals (critical step)

Critically analyze diagnostic data

Do the results align (“make sense”) with expectations?

If not alignment, reiterate process until results make sense

Prioritize detected agents and risk factors

Proximate cause(s) versus ultimate cause(s)

Verify with histopathology when possible

Establish a diagnosis and risk factors relevant to case definition

Interventions, monitoring, and continuous improvement

Treatment, control, prevention, elimination, etc.

Monitor and refine or identify options for continuous improvement

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Veterinary Diagnostic & Production Animal Medicine

Marcelo Almeida, DVM, MS, PhD
Assistant Professor
malmeida@iastate.edu