Diagnostic Tools for Swine Diseases

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Messages

- Diagnostic tests rarely as accurate as expected
- Diagnosis of an infectious disease is rarely made with one test
- Good diagnoses need a combination of a broad knowledge about the herd and the pig (s) in question and experience in combining multiple sources of information
- Expertly combining tests with differing sesnsitivities and specificities is important
- There is always a “when you hear hoof beats, think horses, not zebras” challenge
- Diagnosis of freedom from disease even more difficult

Diagnostics: herd examination

Look at the history of the pigs

- source, location, mortality, culls, previous problems

Look at the pigs

- activity, condition, breathing, urinating, defecating

Look for variation in performance

- weight, activity, condition

Smell the pigs

- eg water deprivation

Examine the resources

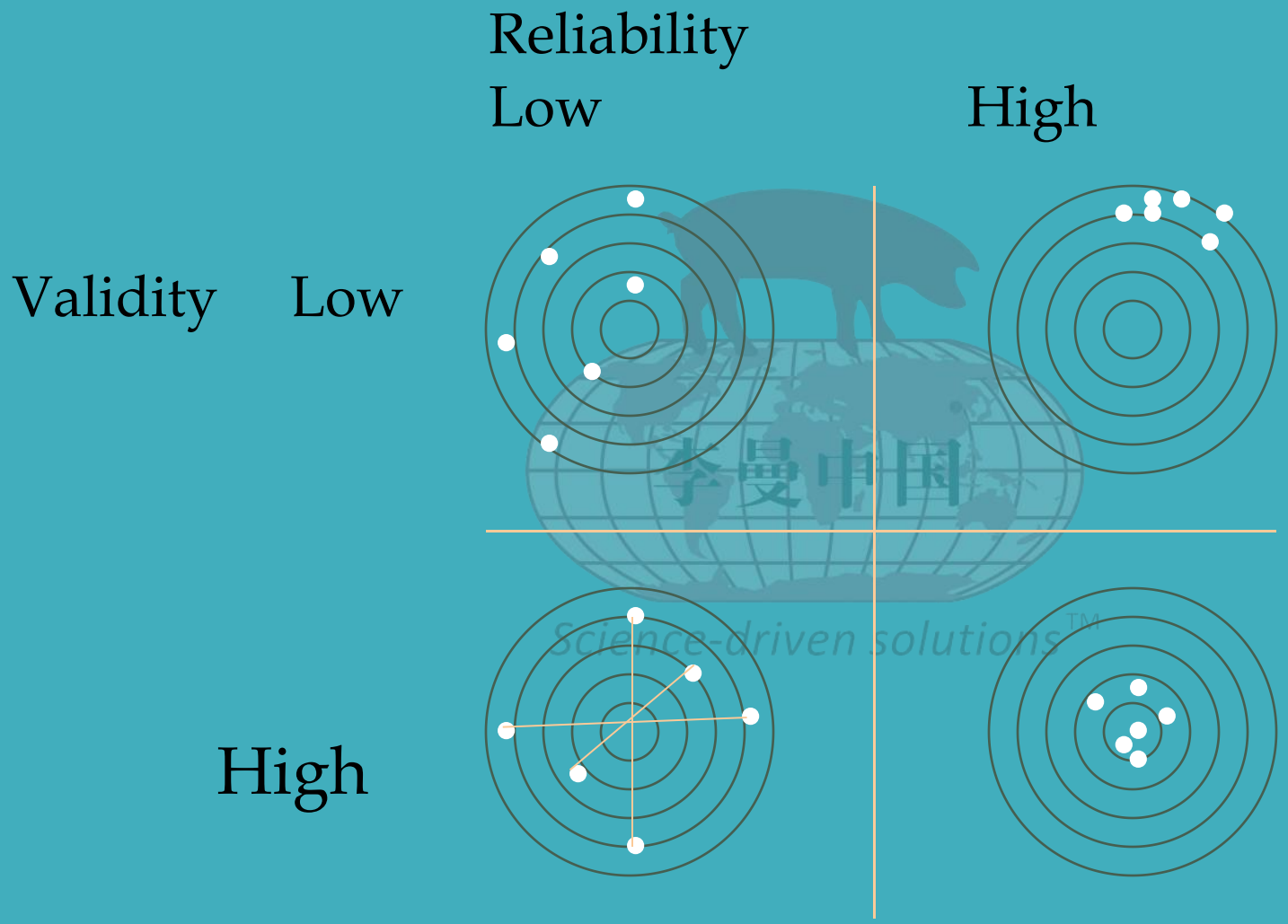
- facilities, feed, water, air

Are we biased or wise?

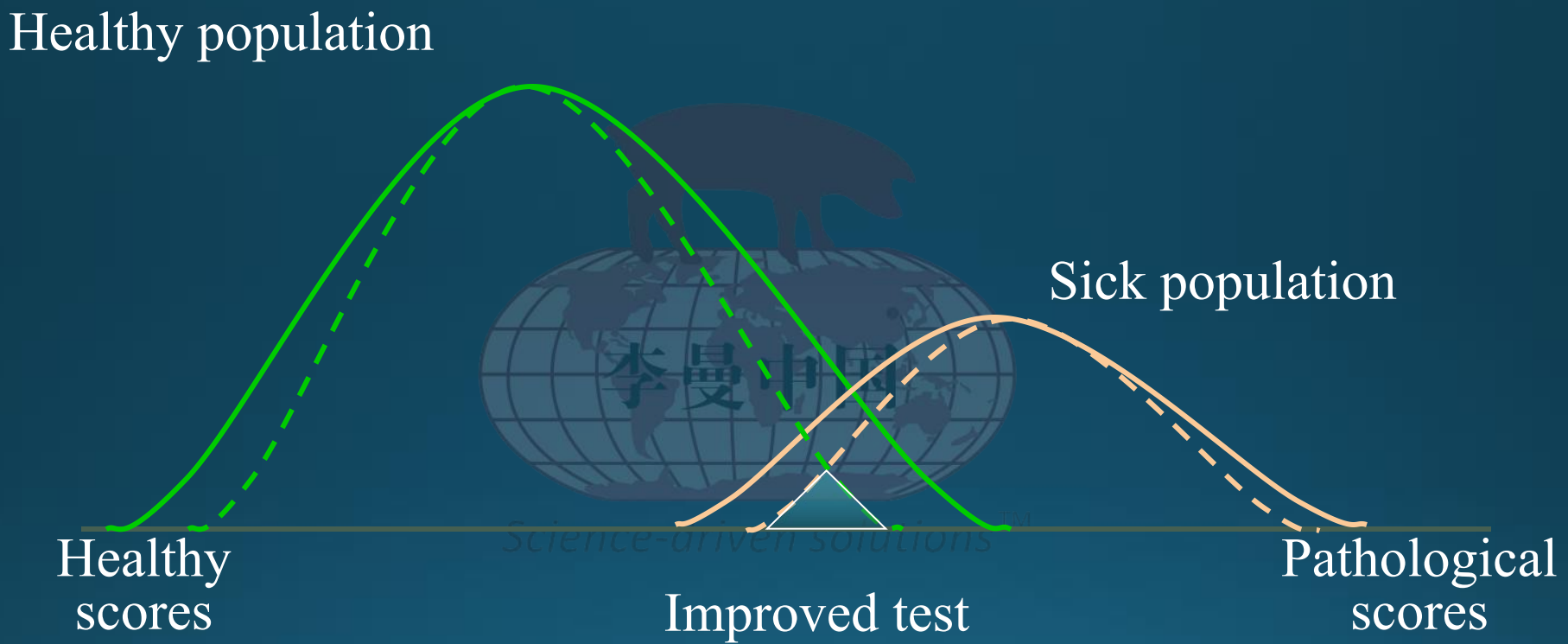
- Diagnoses are based on prior knowledge
- Driven by experiences, training and exposure (prevalence)
- Diagnoses best served by two questions:
  - Is it what **I** think it is - the confirmation
  - Is not what I thought it was – the contradiction

- Wisdom searches for both confirmations and contradictions

Reliability and Validity

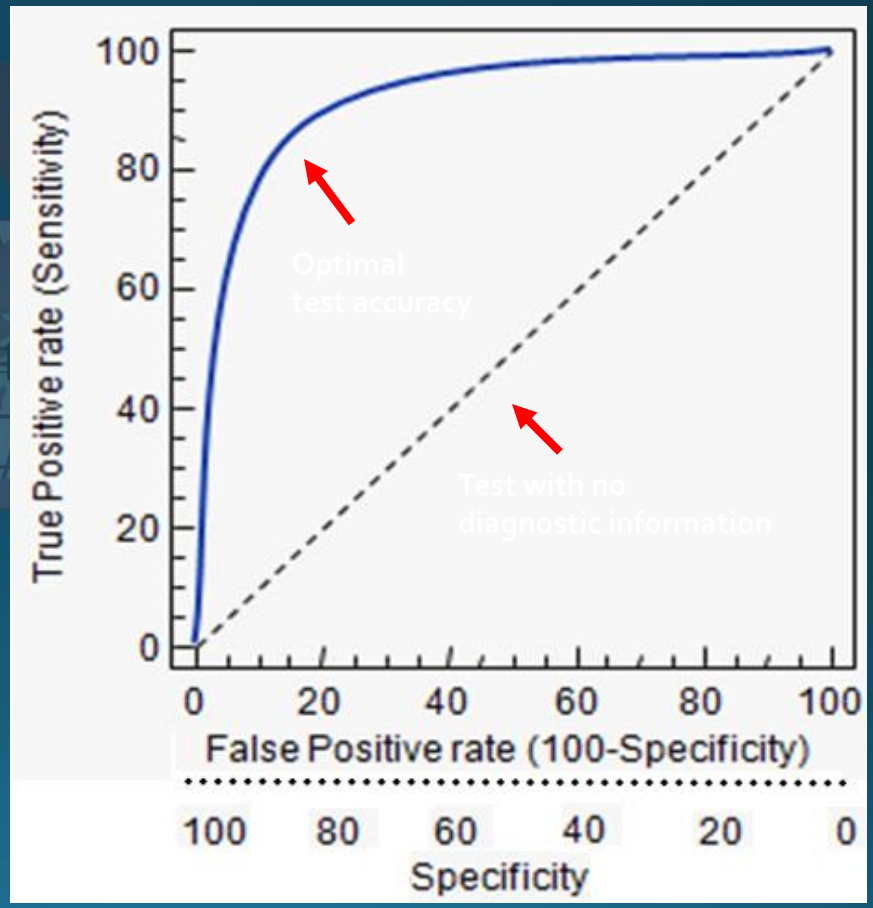


Improving the test:



Receiver Operator Characteristic (ROC) Curves

- Plot of sensitivity *vs* (1-specificity)
- 'Trade off' between sensitivity and specificity
- 'Trade off' between true positives and false positives
- 45° line - test with no discriminative value



Sensitivity

		State	
		Disease	No Disease
Test	Positive	**True Positive**	False Positive
	Negative	**False Negative**	True Negative

(TP + FN)

Sensitivity positivity in disease

TP / (TP+FN)

A Negative test that has a High Sensitivity (i.e., almost no false negatives) helps rule out the disease

Specificity

		State	
		Disease	No Disease
Test	Positive	TP	FP
	Negative	FN	TN

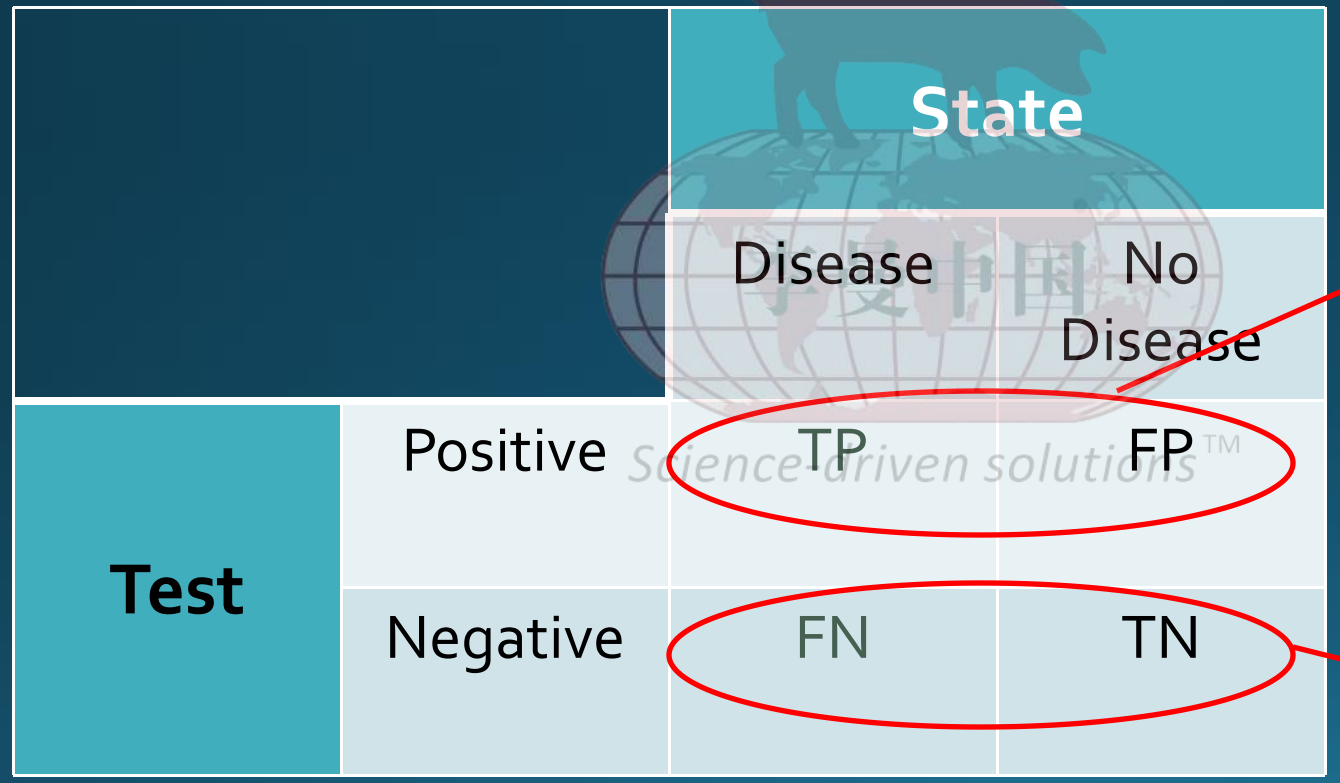
(TN + FP)

Specificity negativity in no disease

TN / (TN+FP)

A Positive Test that has a High Specificity (i.e., almost no false negatives helps rule in the disease

Positive & Negative Predictive Value



PPV disease amongst those with a positive index test

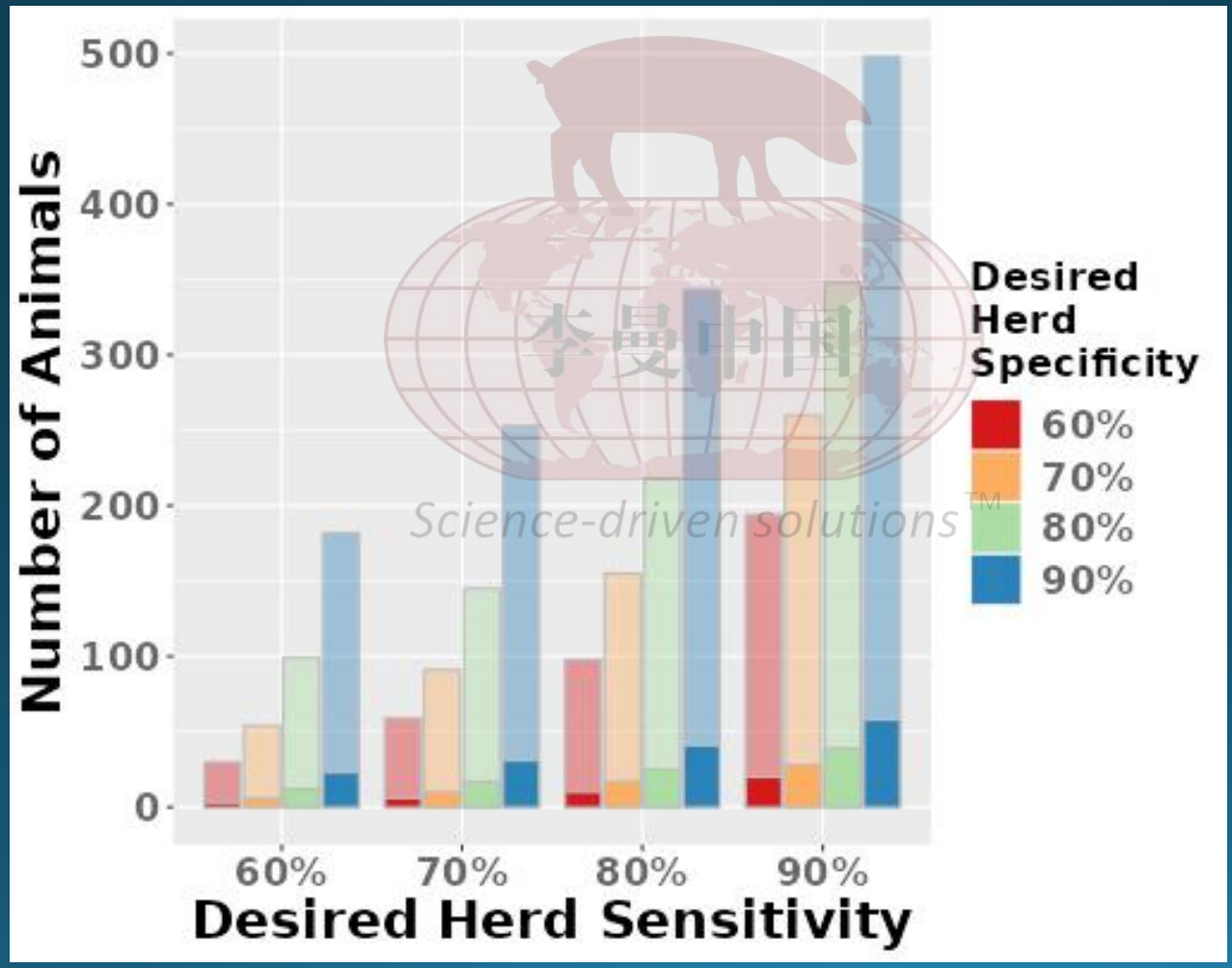
TP/ (TP+FP)

NPV no disease amongst those with a negative index test

TN/ (TN+FN)

Freedom from disease

- https://epidemiology.sruc.ac.uk/shiny/apps/onestagesamplesize/



Baye's Theorem and the Predictive Value of a Positive Test

- The probability of a test demonstrating a true positive depends not only on the sensitivity and specificity of a test, but also on the prevalence of the disease in the population being studied.

- The chance of a positive test being a true positive is markedly higher in a population with a high prevalence of disease.

- In contrast, if a very sensitive and specific test is applied to a population with a very low prevalence of disease, most positive tests will actually be false positives.

Baye's Theorem

Prevalence of Condition (%)	Positive Predictive Value of a Positive Test (%)*
75	98
50	95
20	83
10	68
5	50
1	16
0.1	2

* 95% sensitivity and 95% specificity

Diagnostics: Pathology examination

- Condition
- Skin
- Necropsy (full or partial)
- Histopathology of targeted tissues
- Electron Microscopy

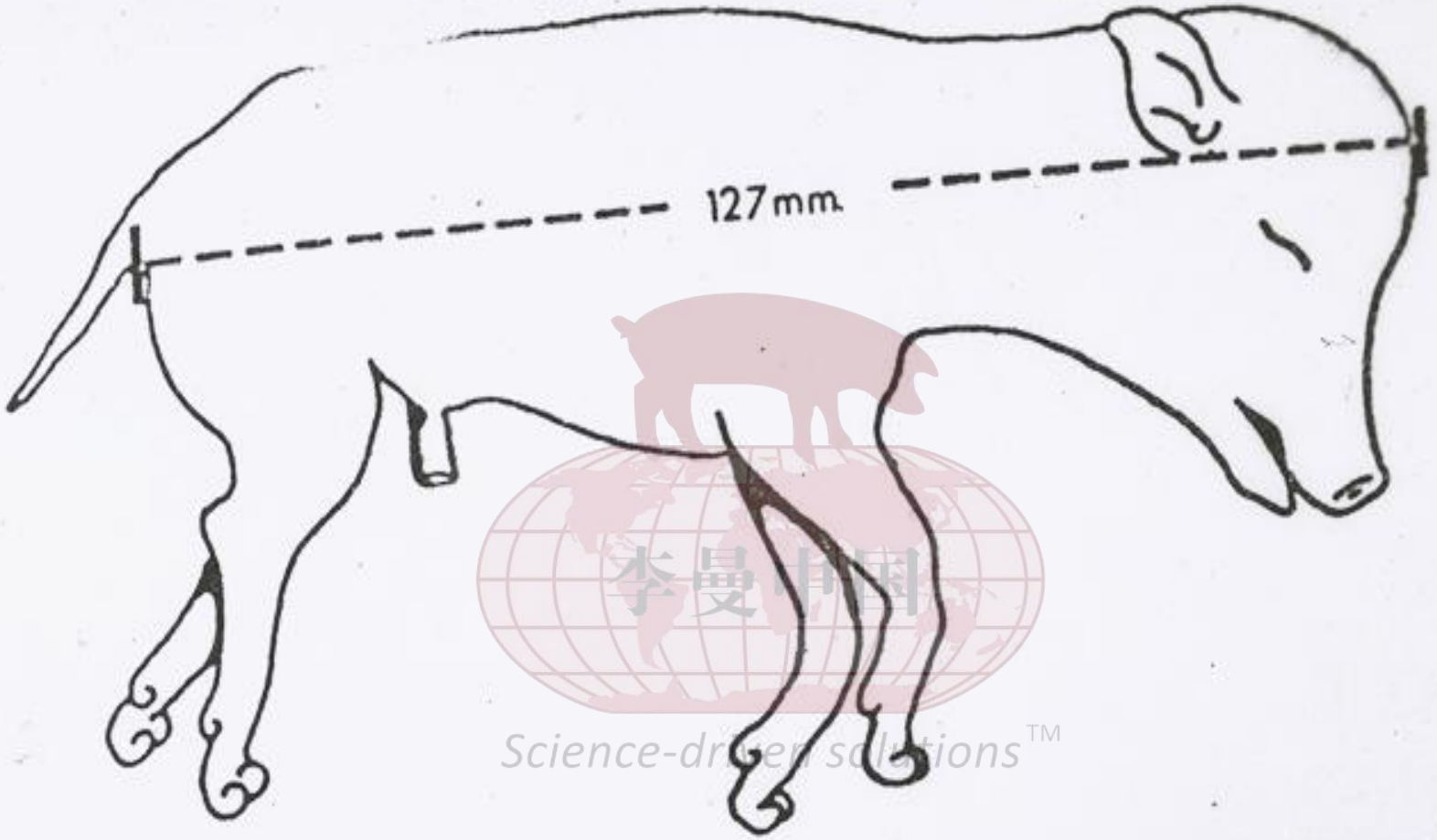
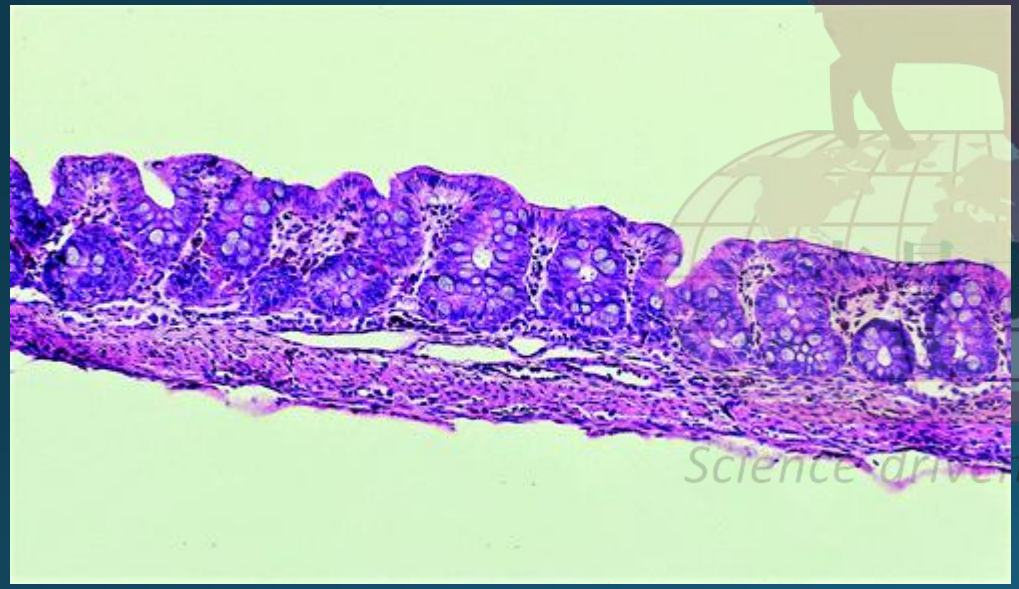


FIG. 5.—Use of foetal body length (crown—anus length) to determine age.
For prediction equation and graph giving conceptual age from body length see Fig. 6b. In this case age = 60 days approx.

Histology a dying skill…



Diagnostics: Targeted Tests

- Microscopic examination
- Culture
- Biochemical tests
- Serological tests
- genetic tests
- Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry **(MALDI-TOF-MS)**
- Next-generation sequencing **(NGS)**

Choice of tests

- Rule-ins
- Rule-outs

- Balancing sensitivity and specificity

- There is no way to eliminate subjectivity

The Challenge of Diagnoses

- Choose tests wisely
- Recognize biases
- Invest in rule-outs
- Constantly review strategies