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Nantes-Atlantic National College of Veterinary Medicine, Food Science and Engineering

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From surveillance to action: towards output-based standards for disease control

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Outline of the presentation

Input-based versus Output-based standards

Illustration on BVDV control activities for safe trade

- **Why consider output-based standards?**
- **Approach to evaluate and compare outputs**
- **Results in western France**
- **From surveillance to action**

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Input-based versus output-based standards

Definitions in the context of animal health control

proposed by More et al (2009)

- **Input-based standards**
  - **Detailed outline on the activity required**
  - **Design, descriptive or prescriptive standards**
  - **Expectation an adequate output will be achieved**
  - **Not true in heterogeneous populations**

- **Output-based standards**
  - **Setting standards of performance to be achieved**
  - **Quantitative specification of the desired result**
  - **Adapt methods and use of resources to the situation**
  - **Concept of equivalence (SPS agreement of WTO)**

Input-based versus output-based standards

Three generation of output-based approaches

(Cameron, 2012)

- **Surveillance sensitivity**
  - **Different tests and tests combinations**
  - **Different sample sizes**
  - **Different sampling strategies (representative or risk-based)**
  - **Examples in OIE Terrestrial Animal Health Code**
- **Probability of freedom**
- **Expected cost of error**

Input-based versus output-based standards

Three generation of output-based approaches

(Cameron, 2012)

- Surveillance sensitivity
- **Probability of freedom**
  - **Multiple source of surveillance**
  - **Historical testing**
  - **Taking into account probability of introduction of the pathogen**
  - **E.g. modelling freedom from TB in deers** *(More et al., 2009)*
  - **Promising but not implemented in practice**
- Expected cost of error
  - **Combines probability and consequences of surveillance failure** *(no added value for our example today)*

Why consider output-based standards?

- **Endemic disease**
  - **Trade in non-free areas**
  - **Non regulated (most often)**
  - **A variety of control plans**
  - **Infectious animals often don't show clinical signs**
  - **Information asymmetry (sellers vs buyers)**

- **A variety of epidemiological situations**

- **High demand of stakeholders for proof of equivalence**

BVDV control and safe trade

Why consider output-based standards?

- **A voluntary BVDV control scheme has been implemented in Brittany (Western France) since 1998**

- **The control scheme is based on**
  - **herd monitoring**
  - **detection and slaughter of PI animals**
  - **safe trade of live animals**

- **13 000 dairy herds and 6 000 beef herds are enrolled**

- **How to guarantee safe trade i.e. no PIs are sold?**

Approach to evaluate and compare outputs

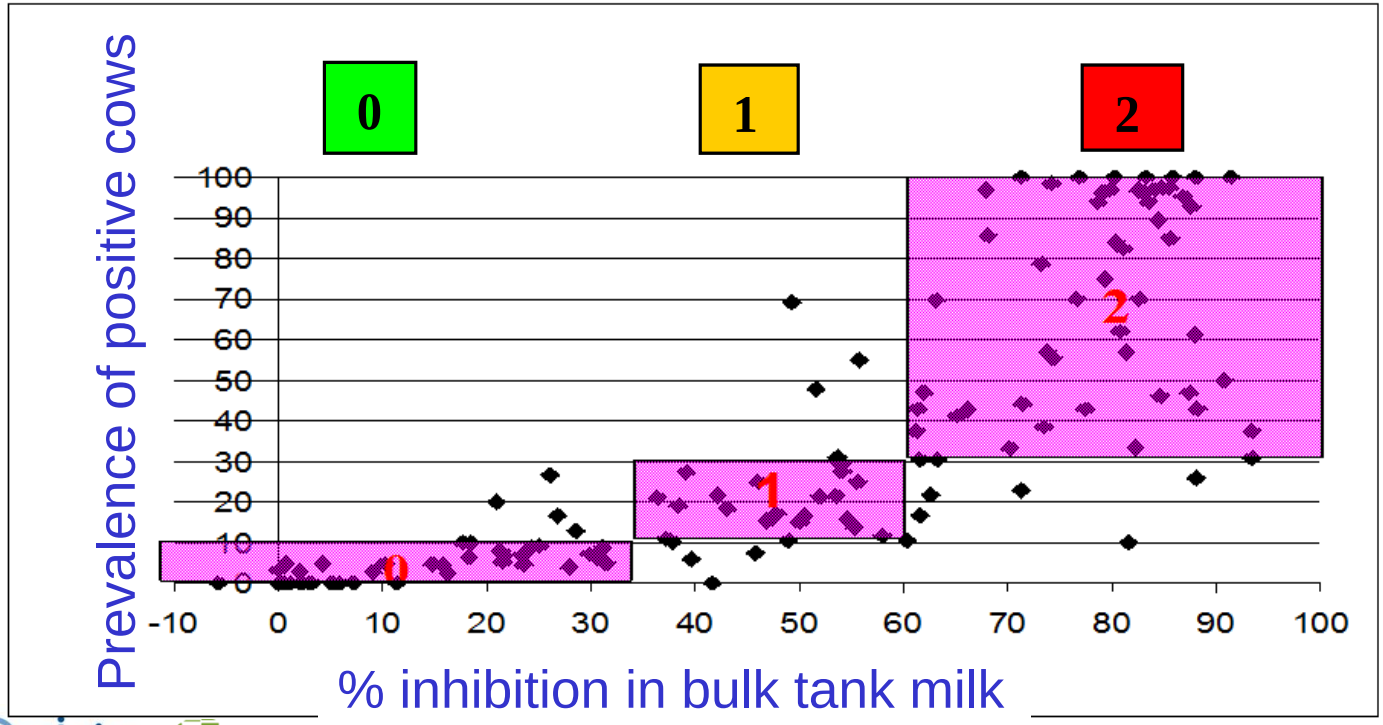
Steps and principles: probability of freedom

- Approach at the individual animal level
- To agree on a threshold for output-based standard
- To identify the target population: cattle under surveillance or control actions and likely to be sold
- To list possible criteria to achieve the standard
- To monitor the status of the certified non PI animals
- To evaluate the criteria / threshold
- A continuous process to update the list of criteria and the results

Approach to evaluate and compare outputs

Dairy herds are classified into 3 categories according to BVDV antibodies in bulk tank milk

- **ELISA-Ab tests in bulk tank milk (BTM) every 6 months**
- **After 3 consecutive results in the category 0 => herd « presumed free of BVDV »**



- *Pilot study in 124 herds*
- *Blocking NS2-3 ELISA (LSI)*
- *Results in % inhibition*

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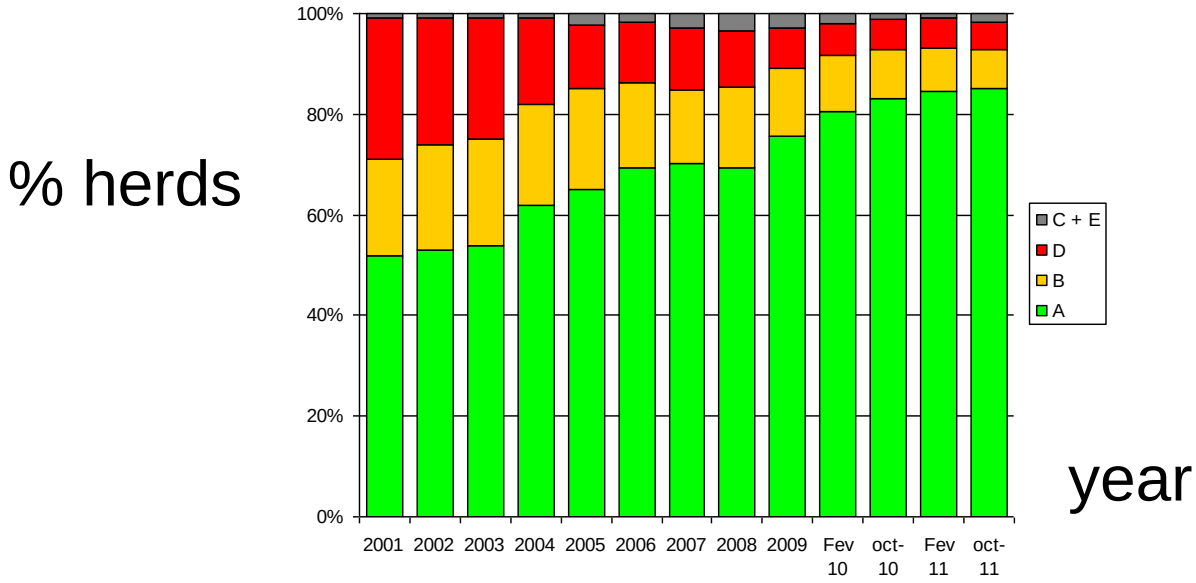
Approach to evaluate and compare outputs

How to use herd status information?

- **All cows from herds with repeated very low or low BTM ELISA Ab are assumed to be non-PI**



- **How does this information compares with individual testing to certify that animals are non-PI?**

Approach to evaluate and compare outputs

Choice of a threshold for output standard

- **Probability for an animal classified as non-PI to be PI**
  - **Estimated as: 1 – NPV**
- **Hypotheses**
  - **Reference test (2002): antigenemia**
  - **Data from literature**
    - **Se (sensitivity) = 0.99**
    - **Sp (specificity)= 0.99**
    - **Prevalence in an endemically infected population : P = 2%**

- **NPV = 0.9998 -> 1 – NPV = 0.0002**

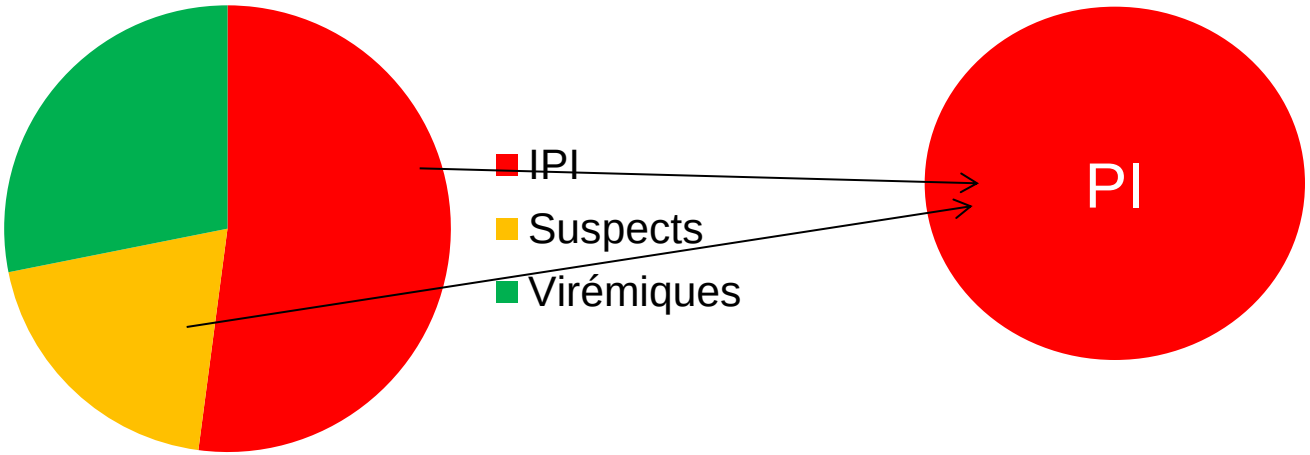
➔ **Acceptable threshold: maximum 1 PI out of 5,000**

Approach to evaluate and compare outputs

Follow-up and assessment of failure events

- **Database of all non-PI animals**
  - **Repeated assessment of the status when a criteria is met**

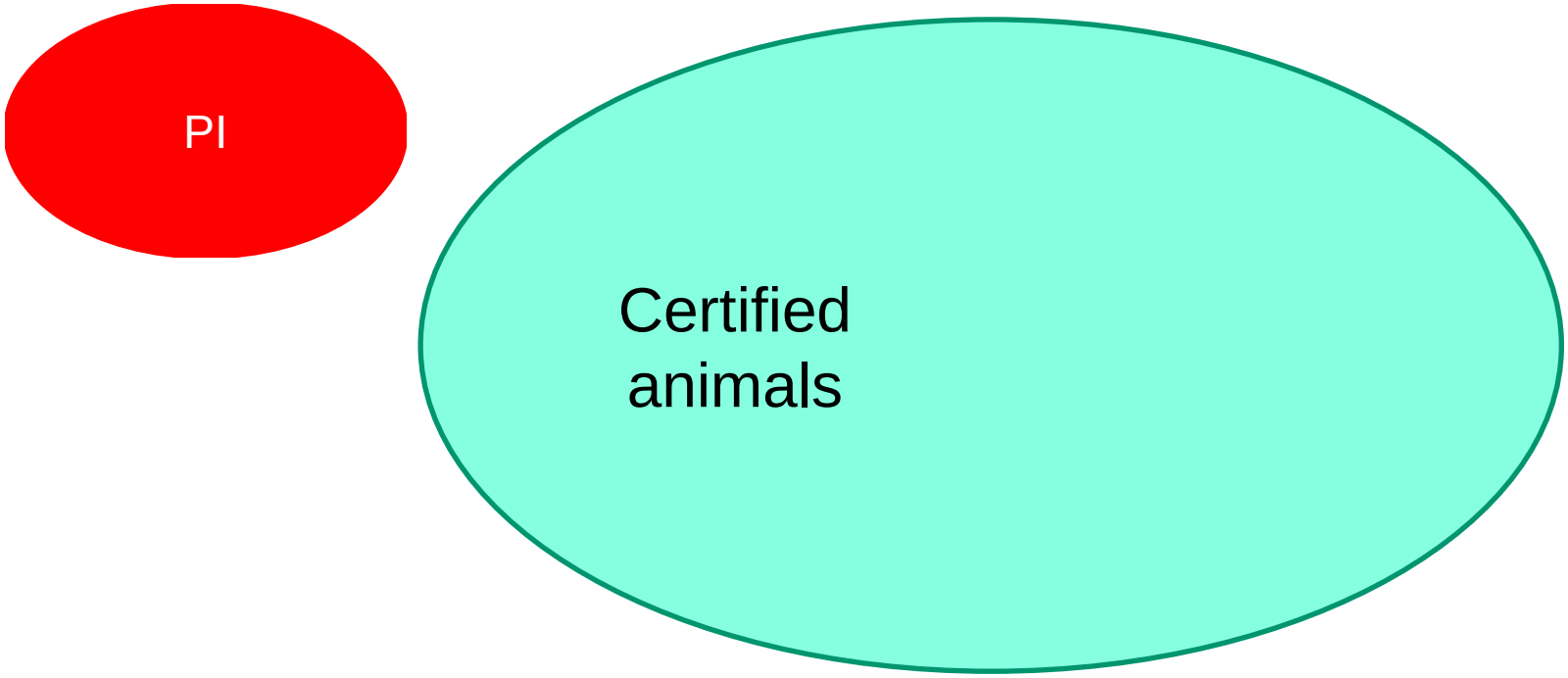
- **Database of all virus positive cattle => list of "PI"**
  - **Confirmed PI**
  - **Not PI: transiently infected**
  - **No other test: PI suspect**



Approach to evaluate and compare outputs

Calculation of the failure rate

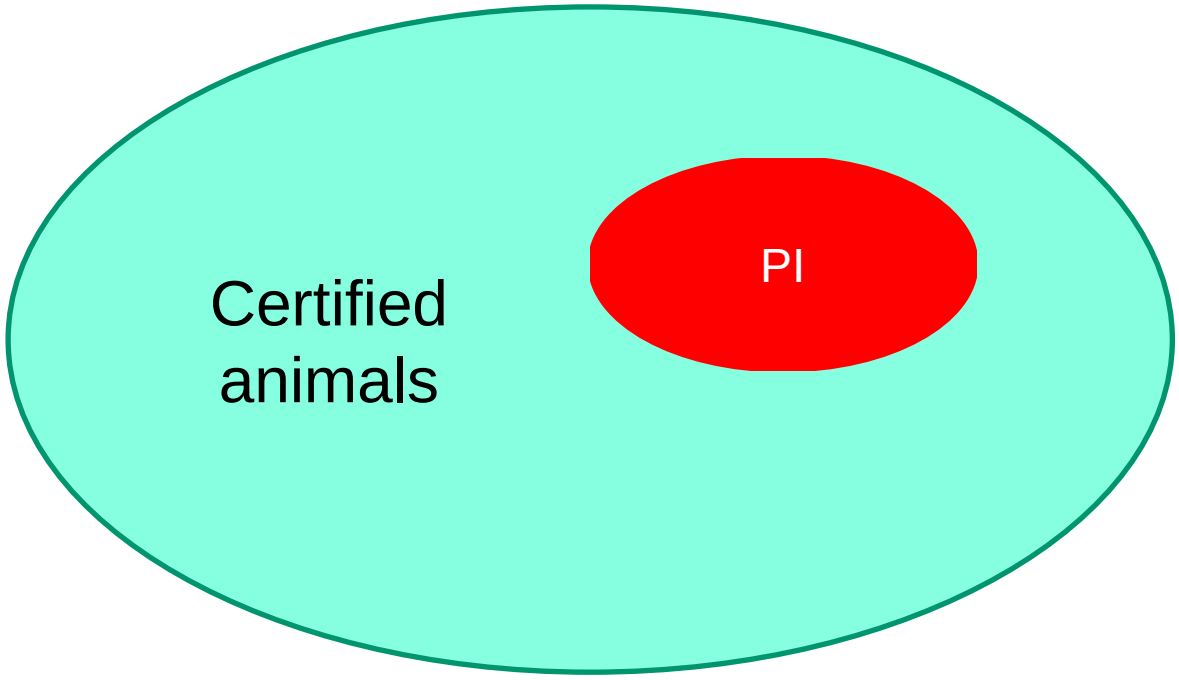
- **Ideally: all the PIs should NOT be certified as non-PI**



Approach to evaluate and compare outputs

Calculation of the failure rate

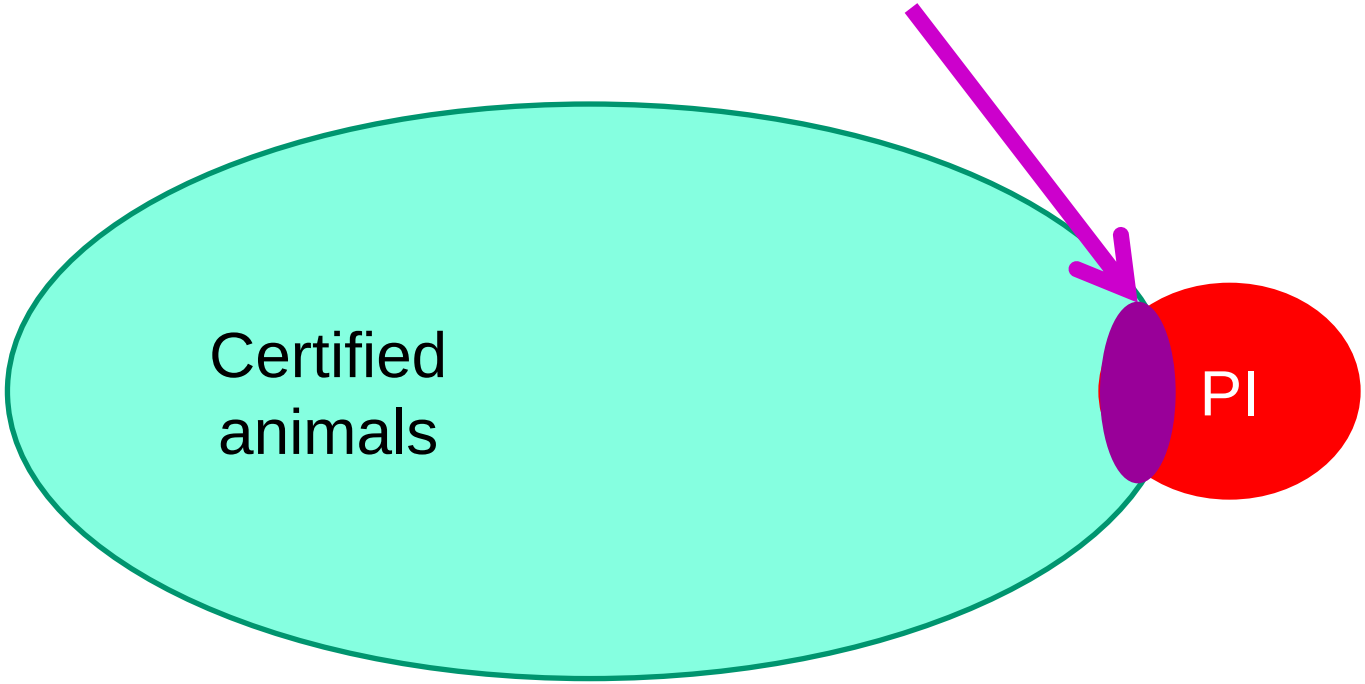
- **Critical situation: all the PIs would be certified as non-PI**



Approach to evaluate and compare outputs

Calculation of the failure rate

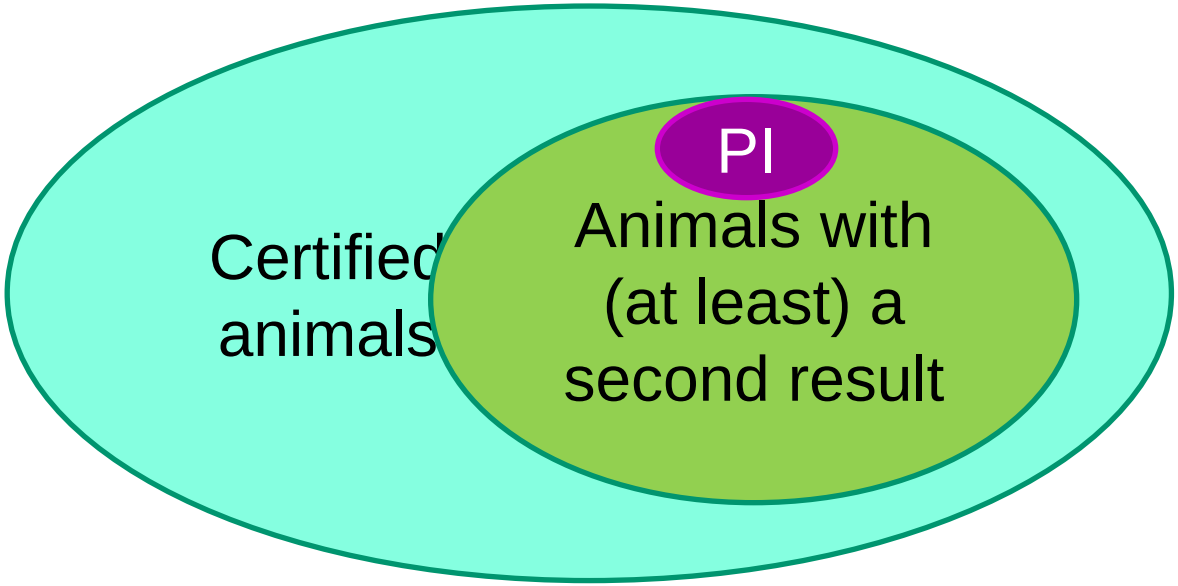
- **In reality: a fraction of the PIs are certified as non-PIs ➔ failure events**



Approach to evaluate and compare outputs

Calculation of the failure rate

- **Accounts for only animals with at least a second result**



Approach to evaluate and compare outputs

Calculation of the failure rate

CRITERIA	Nb of animals (y)	Nb of Fails	Rate of success
Cows of free herds	516 947	0	100,00000%
Cows of herds low level of AB	162 465	1	99,99938%
PCR Neg	34 185	2	99,99415%
BMT PCR Neg	20 974	2	99,99046%
Antibody Pos	47 218	10	99,97882%
Antigene Neg	48 774	6	99,98770%

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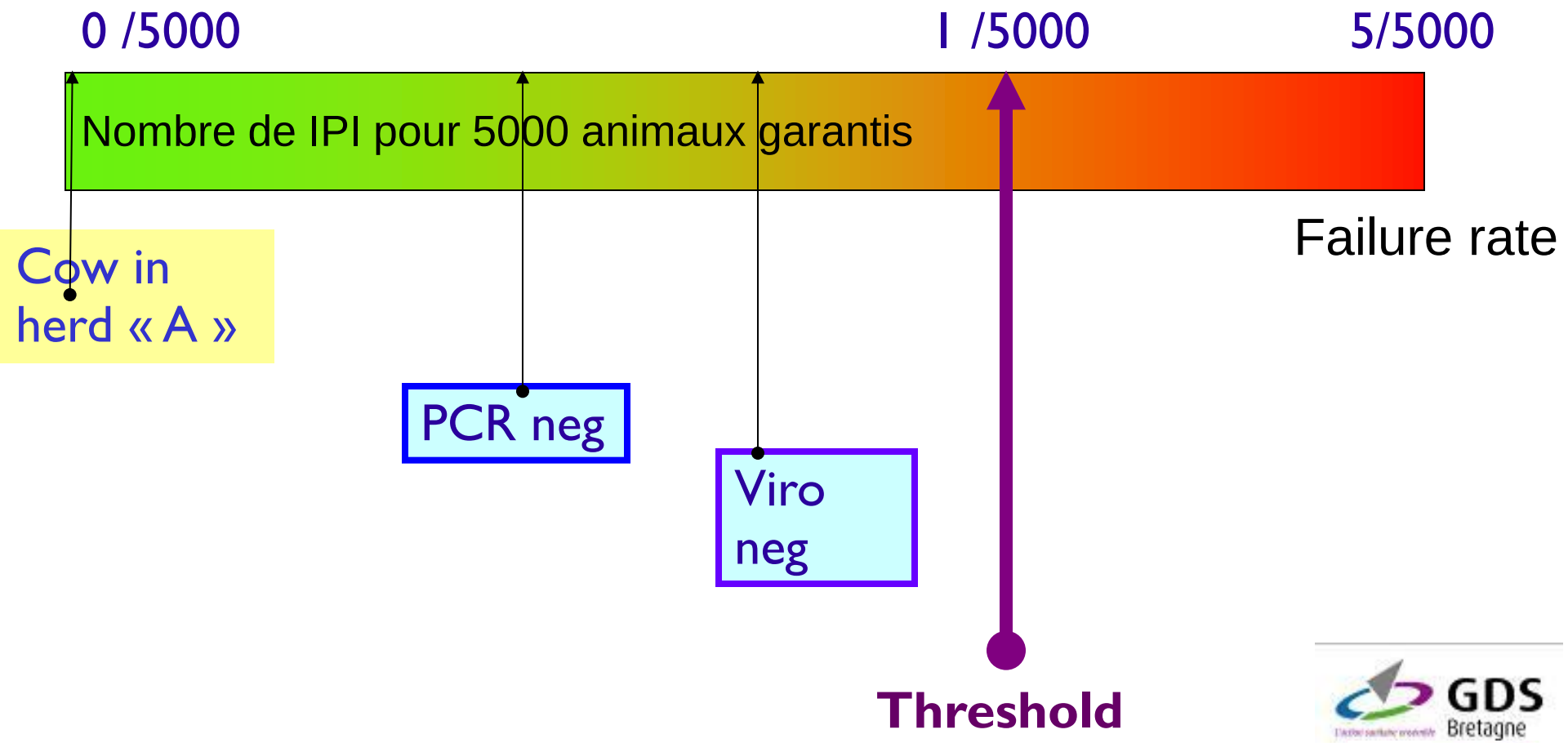
Results in western France

- ✓Criteria based on individual testing
- ✓Criteria based on herd status



Results in western France

Need for other criteria

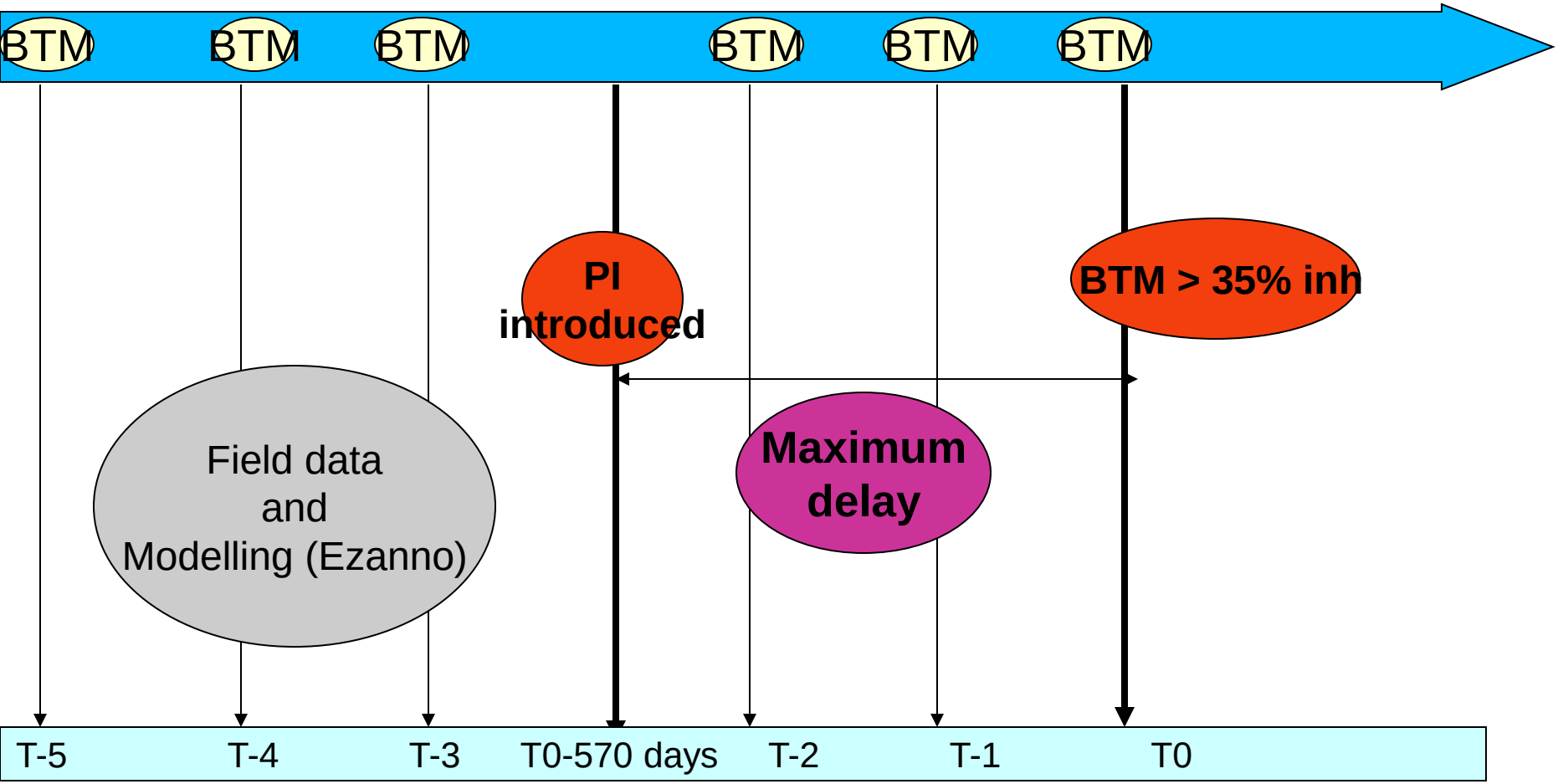
- **To cover cattle populations of interest for trade**
  - **Youngstock for replacement**
  - **Calves before weaning**
- **Selection of herds with 6 consecutive results in category 0 *(dates of BTM ELISA = T1 to T6)***
  - **Groups of animals based on age at T6**

- **Heifers older than 19 months at T6**

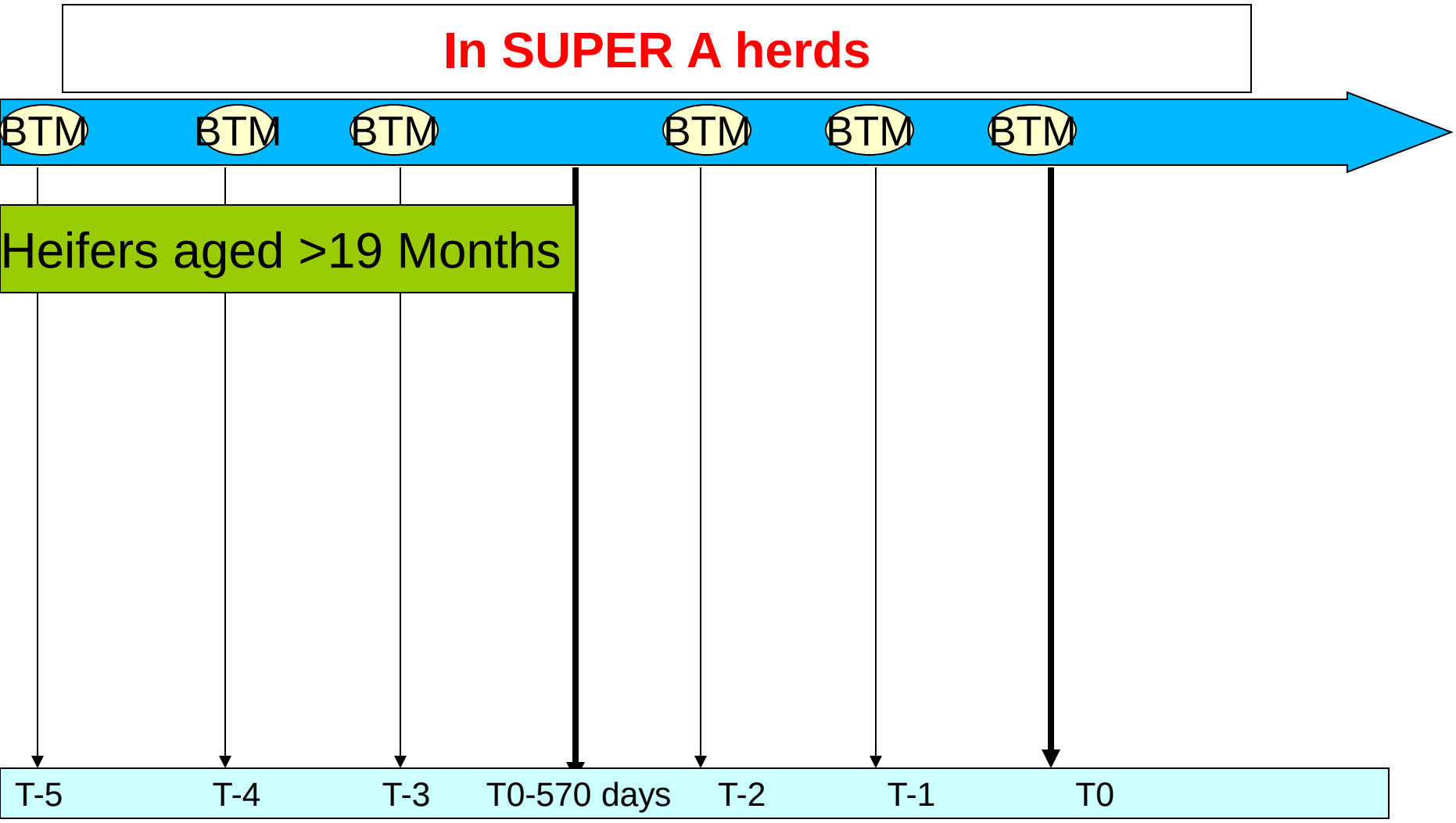
- **Heifers aged from 0 to 19 months at T6**

- **Calves born between T6 and T6 + 90 days**

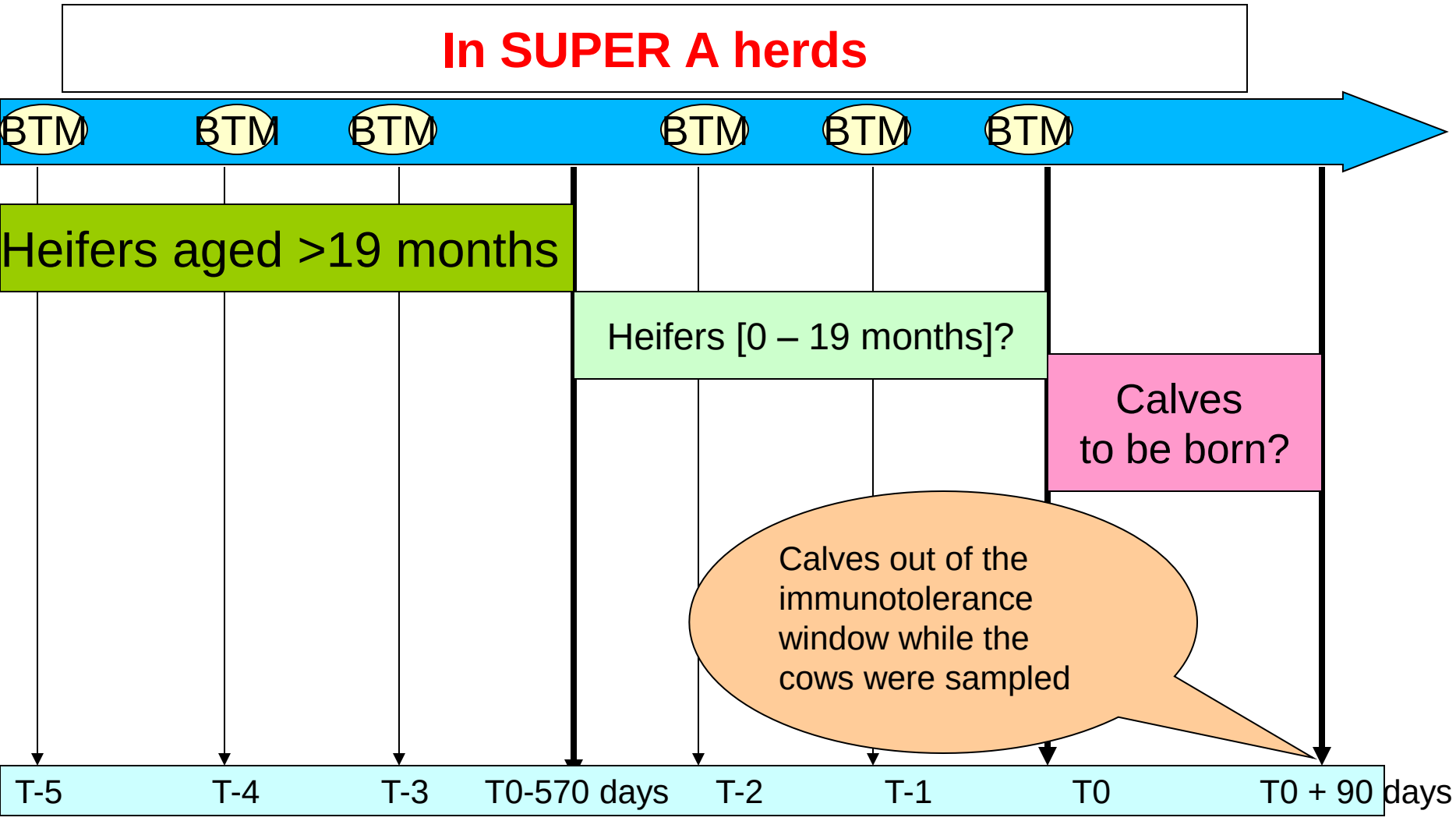
BTM herd status and youngstock certification



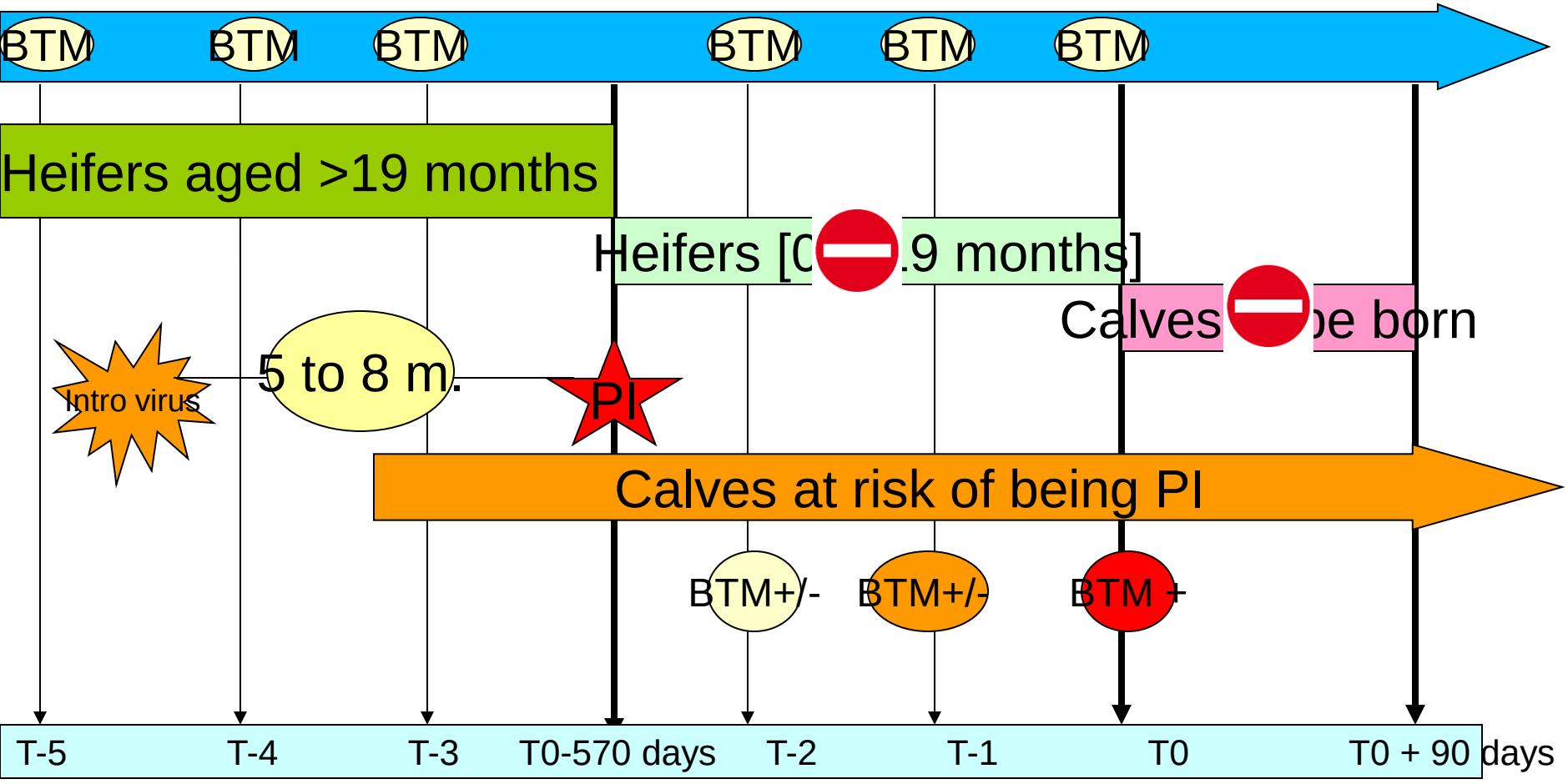
BTM herd status and youngstock certification



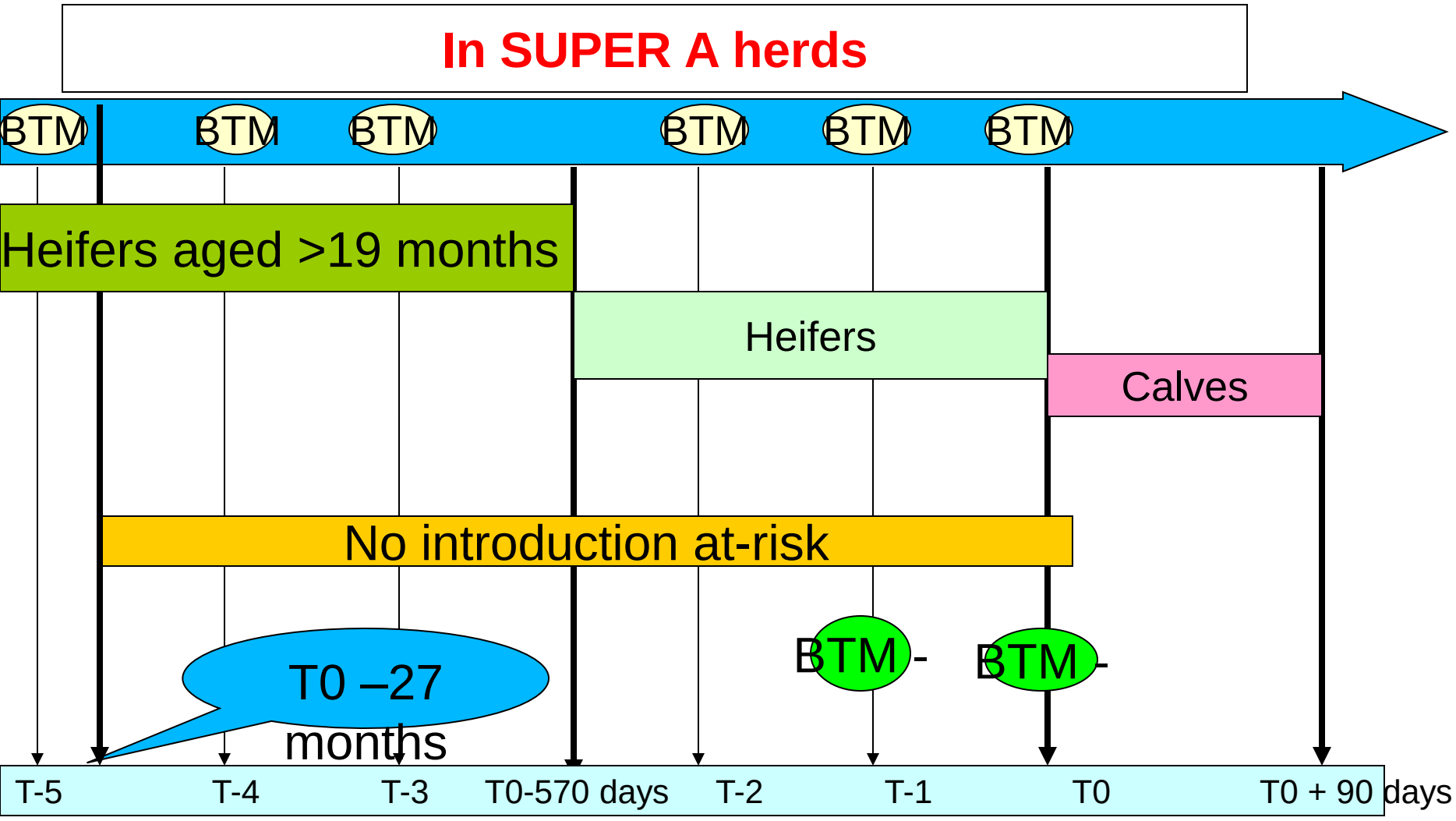
BTM herd status and youngstock certification



BTM herd status and youngstock certification

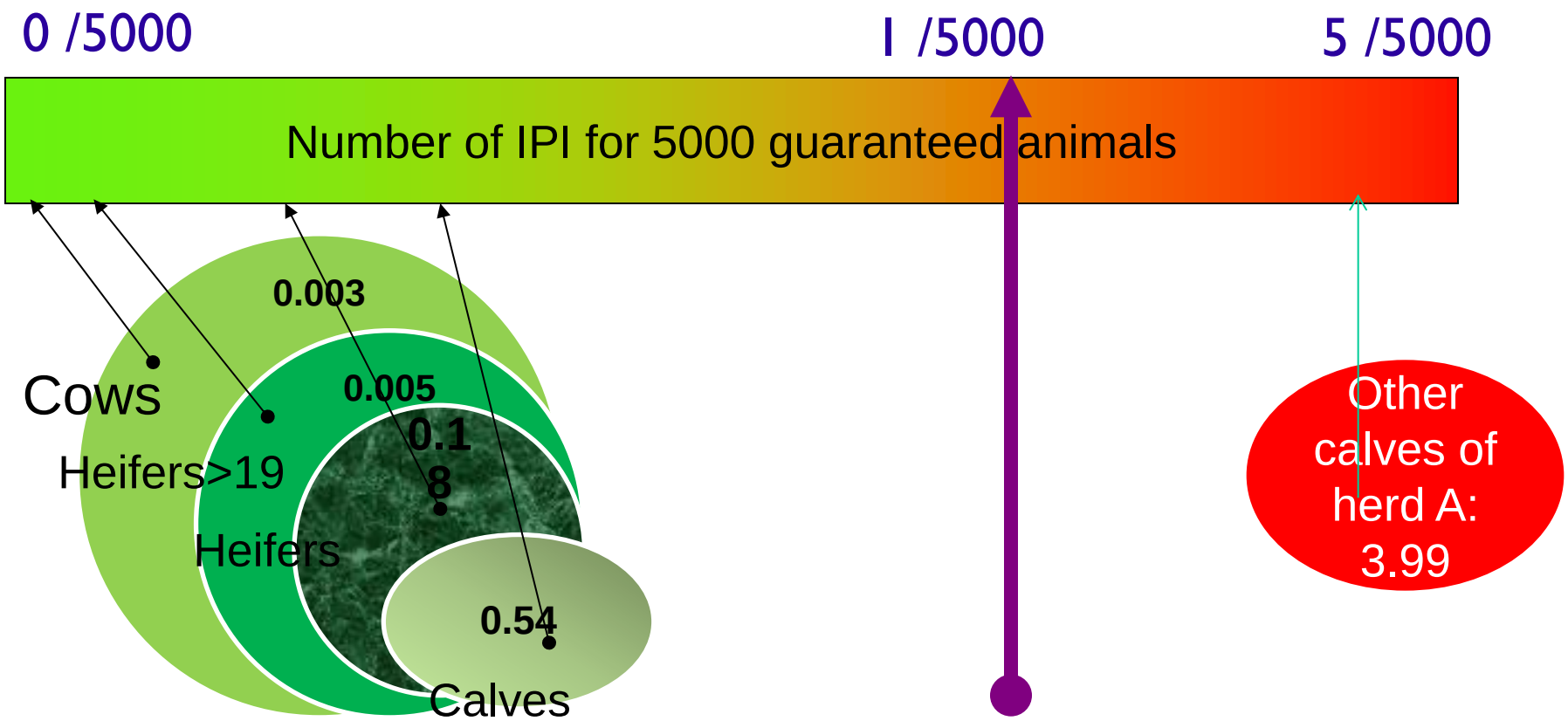


BTM herd status and youngstock certification



BTM herd status and youngstock certification

Epidemiological criteria: herd status + introductions



- no risky introductions
- Very low BTM

Investigation of other criteria

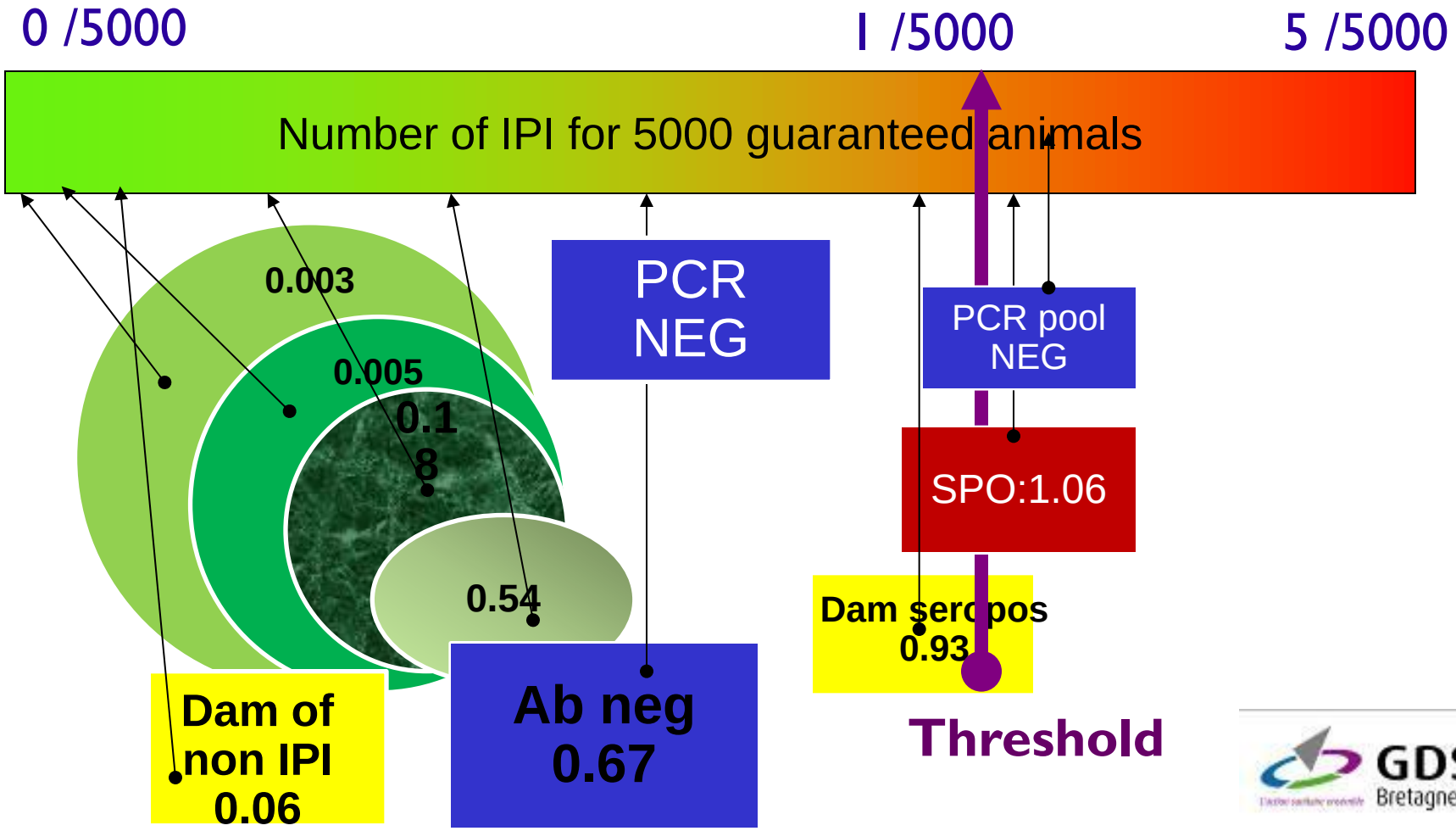
To best use available information

- **Tests on pooled samples**

- **Pathogenesis of the disease**
  - **All calves born from PI dams are PI: non-PI calf => non-PI dam**
  - **Calves from dams seropositive before pregnancy cannot be infected (in a non-vaccinating herd)**
  - **…**

Results for all criteria / standard

Equivalence of 8 criteria out of 10 / accepted threshold



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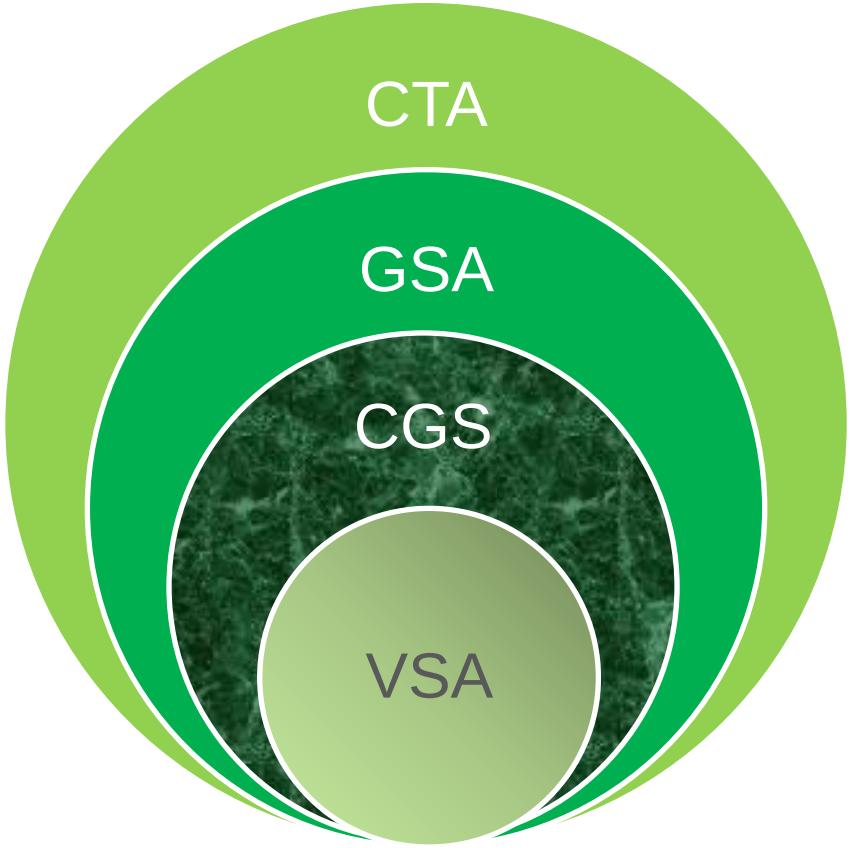
Overview of the criteria evaluated

AG NEG	PCR NEG
PCR MIX NEG	SERO POS
Dam of non PI	Dam Sero Neg
Dam Sero Pos	Sero Neg Group



From surveillance to action

A variety of criteria = inputs for equivalent outputs

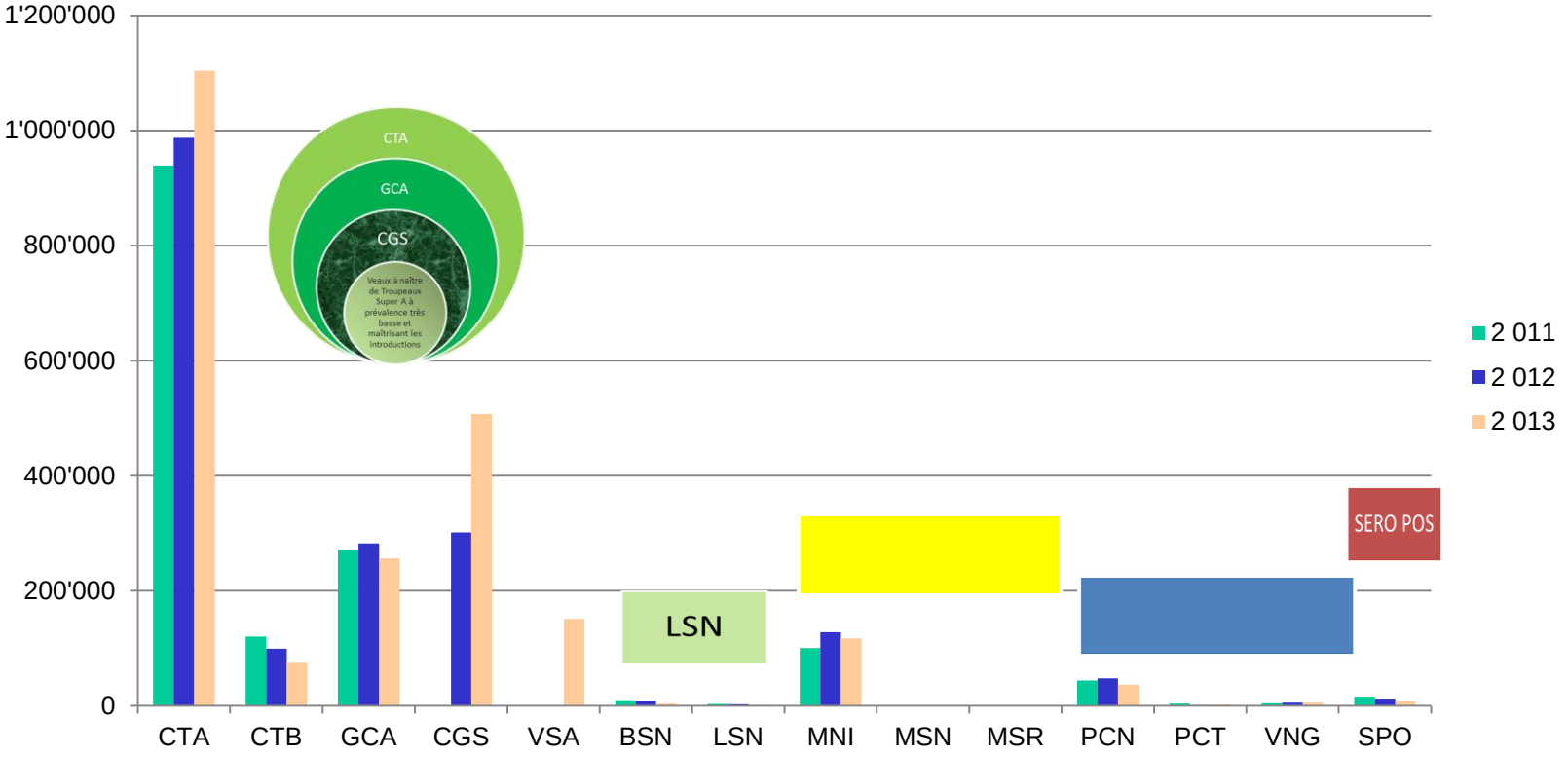
- **Testing on the animals individually or in pools**
- **Herd status issued from monitoring data**
  - **Historical results of testing**
  - **Not only animals subject to monitoring**
  - **Some criteria hypothesized from modelling studies**

- **Knowledge of the pathogenesis of the disease**
- **Epidemiological information**
  - **Including risk factors considerations (introductions)**

Coverage / contribution of the criteria

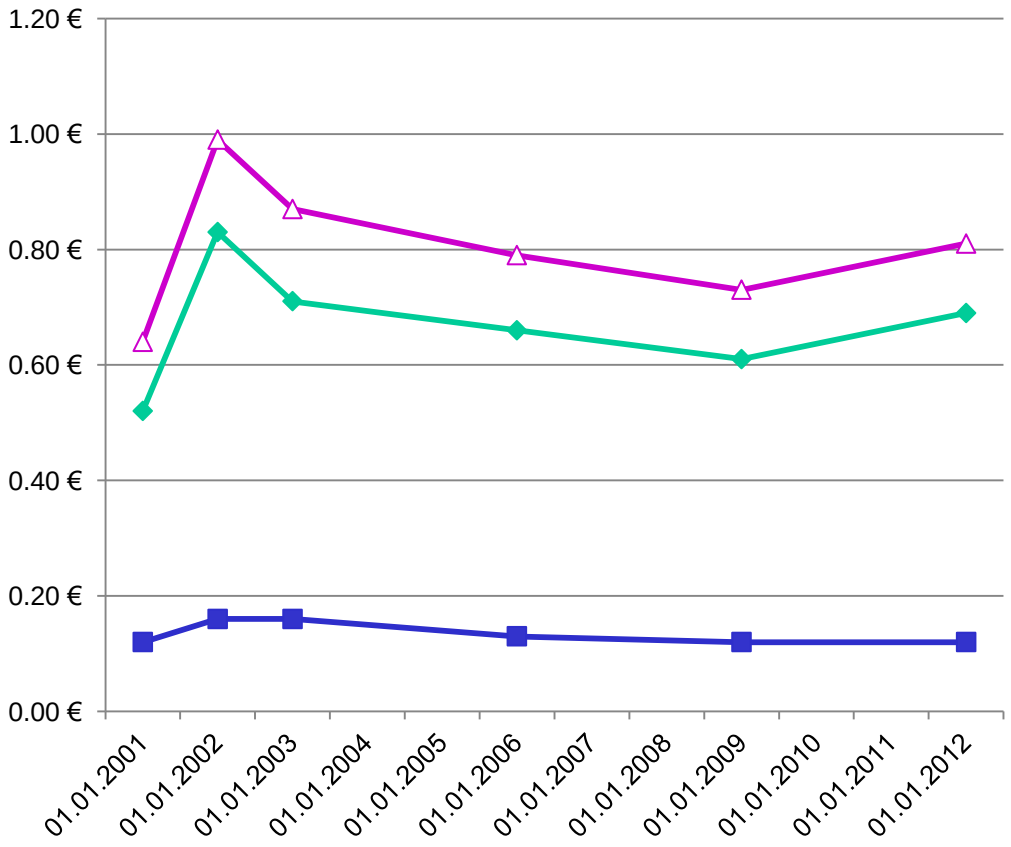
- **Number of certified non-PI animals**

Distribution of the number of certified animals according to criteria family from 2011 to 2013



Overall cost of the system

– **Total costs <1€ / head including control cost in infected herds**



Total cost

Test and control

Staff cost

Involvement of stakeholders

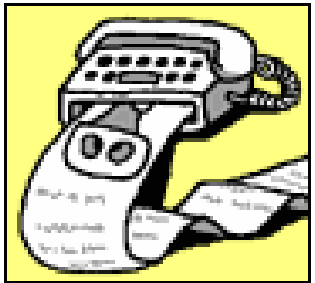
- Understanding and agreeing on the concept
- Choice of the threshold: explicit acceptance of the chance of failure
- Request for new criteria to cover gaps in traded animals
- Request for new criteria to use available information at best

Dawid Ryski

From surveillance to action

Implementation

- **Nationally**
  - **Threshold for output agreed at the national level**
  - **Validated criteria discussed and progressively included in ACERSA certification procedures**
- **Regionally**
  - **Comprehensive database**
  - **Farmers have the list of non-PI animals in their herd**
  - **Farmers have access to the database in case of trade**
  - **Website (buyer farm ID + animal for sale ID)**



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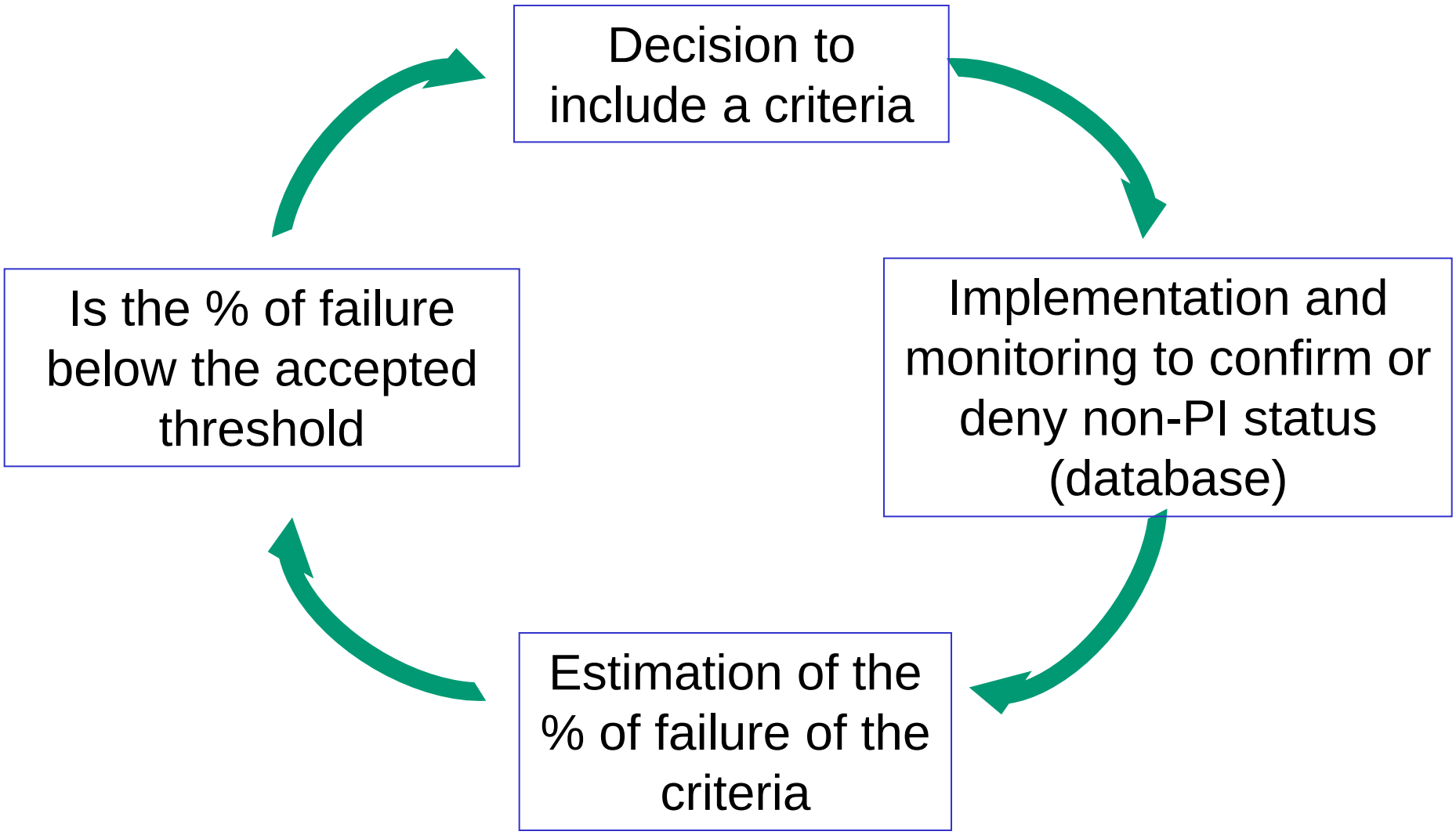
Evaluation of the output-based standards approach



Evaluation of the output-based standards approach

Level of performance to achieve

Equivalence

Variety of possible “surveillance” methods

Best use of available resources

Information to optimise cost of certification

Thanks for your attention !

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