



Animal Health Matters.
For Safe Food Solutions.



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER

State Secretariat for Economic Affairs SECO



Use of multiple diagnostic tests (series and parallel interpretation)

Marco de Nardi

PVs: Control or Eradication program

- Beginning of campaign (Prevalence 30%):
 - Good Test (Se: 95%, Sp: 90%) is acceptable
 - PPV: 80%
- Middle campaign (Prevalence decrease):
 - PPV decrease (higher probability of F+)
 - Increasing proportion of healthy animals are destroyed
- Final phase (Prevalence 3%):
 - PPV: 23%
 - Need of a test (or a strategy) to increase the sensibility and, above all, the specificity (reduce the probability of F+) > i.e. series interpretation





Use of diagnostic tests

- **Screening program:** **high sensitivity** (few F-). Want to find as many diseased animals as possible (F + are accepted);
- **Livestock sale:** **high specificity** (few F+). Want to be sure every test positive is truly diseased (economic implications).



Use of diagnostic tests

- **Screening of import animals introduced into free herds or country:** **high sensitivity** (few F-). Want to be sure animals introduced are  from the disease (F + are accepted);
 - **Periodic monitoring for disease free status:** **high specificity** (few F+). Want to be sure every test positive is truly diseased (minimizing risk of having F+).
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Use of multiple diagnostic tests

- Use of different tests for the **same disease** on a single animal;
- Use of different tests for **different diseases** on a single animal;
- Use of same test multiple times.

Goal: to reduce **uncertainty**-increase **accuracy**





Use of multiple diagnostic tests

- Use of different tests for the same disease on a single animal at the same time;
 - Tests should be different as they measure different biological parameters (different information);
 - Parallel and Series interpretation.



Parallel interpretation

- An animal is considered to have the disease if **one or more tests** are positive;
 - 1° test positive 2° not required
 - 1° test negative  2° is performed
 - 
- Increase **Se**, decrease **Sp**: disease less likely to be missed but F+ are more likely.
- Recommended for rapid assessment and routine examination



Series interpretation

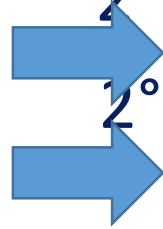
- An animal is considered to have the disease if **all tests** are positive

- 1° test positive

2° is performed

- 1° test negative

2° not required



- Increase **Sp**, decrease **Se**. More confidence can be attributed to positive results (less F+).
- **Not** recommended for rapid assessment



Series interpretation

- **Screening and confirmatory testing**

- **1° test (screening test):**

- highly sensitive, reasonably specific (not many F+!)
- possibly easy to apply and low cost
- negative results are definitive negatives

- **2° test (confirmatory test):**

- highly specific
- require higher technical expertise, more expensive
- positive results are definitive positives



Formulae to calculate combined test Se and Sp

$$Se(\text{series}) = Se1 \times Se2$$

$$Se(\text{parallel}) = 1 - (1 - Se1) \times (1 - Se2)$$

$$Sp(\text{series}) = 1 - (1 - Sp1) \times (1 - Sp2)$$

$$Sp(\text{parallel}) = Sp1 \times Sp2$$





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Thanks