Brucellosis surveillance in Piedmont: a decision tree as a tool to support decision making

Nicoletta Vitale, Antonio Barbaro, Francesca Rubinetti, Laura Chiavacci

Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d'Aosta

Introduction

Since 1964 an eradication plan has been activated in Italy to contrast bovine Brucellosis (BRC), the highly infectious zoonosis. Several areas are nowadays officially Brucellosis free (OBF) or next to obtain the OBF status.

As expected over the course of the eradication program the pre-test probability of BRC has declined dramatically, positive predicted value of serological tests decrease and so false positive serological reactions (FPSR) are observed.
FPSR related to BRC represent a serious problem as:

- the herds temporarily lose OBF status, cattle trade is stopped;
- detection of BRC may be delayed
- the surveillance system is discredited generating additional costs of surveillance programs.

The objective of the study was to create a decision-tree to support decision making to identify the better strategy to apply when positive serological reactions for BRC are observed and prevalence is low as in the Italian northwester region Piedmont.

Method

A decision tree was constructed using tree-age® software a decision analysis add-in software program.
The starting point of the tree was the presence of one or more reactors in a OBF herd.
Based on the current EU legislation (97/12/EC) the effect of three strategies on BRC dynamics was modeled:

- Isolation of reactors test herd (IRTH)
- Test and Slaughter of reactors (TSR)
- Stamping out (SO)

A simplified diagram of the tree-model is show in figure 1.
The model culminates in a chance node for true infection status. Outcomes are measured as a utility fixed by expert opinion ranging from 1 no action in presence of FPSR to 0 for stamping out and OBF status revoked in presence of FPSR.
Each step (or node) is associated with a probability of a positive or negative outcome. Probability estimates are provided in Table 1. The parameters were calculated running logistic regression performed with proc genmod SAS® systems by considering:
Test parameters (sensitivity, specificity, positive predicted value, negative predicted value, pretest probability).
Rates of: abortion in the herds, positive and negative retest calculated on 10 years of BRC epidemiosurveillance data
Presence of risk factors for BRC estimated by case-control study considering 41 BRC outbreaks (case, with isolation of B. Abortus) and 390 OBF herds (control, random samples of OBF herds).
Two scenario were considered: with and without abortion.

parameters	p	IC 95%	
bovine introduction	0,85	0,81	0,88
grazing	0,80	0,75	0,83
proximity with wildlife	0,79	0,74	0,83
herd density	0,80	0,75	0,83
prevalence	0,03	0,01	0,8
abortion in the herd	0,58	0,23	0,78
positive at retest	0,53	0,45	0,71
retest herds	0,11	0,01	0,41
sensitivity	0,79	0,68	1
specificity	0,99	0,9	1
NPV	0,94	0,8	1
PPV	0,19	0,03	0,56

Table 1 parameters estimated

Results

When the prevalence is low (under 0.5%) and without abortion in the herd the best strategy is isolation and retest of reactors.
When the prevalence intra-herd is under 40% and abortion is registered in the herd the best choice is culling of reactors.
Stamping out is convenient only if prevalence intra-herd is up to 40% (fig. 2).

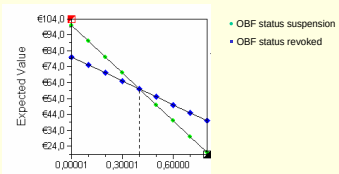
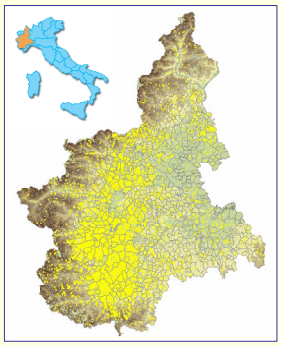
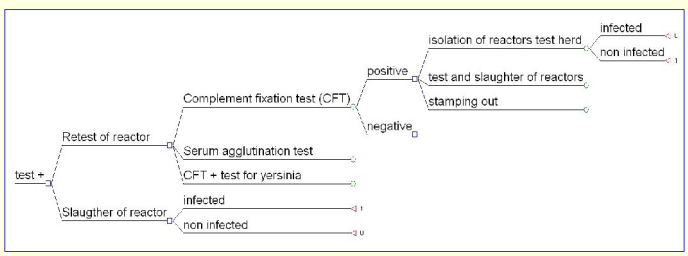


Fig. 2 best strategy SR



Map of Piedmont

Fig. 1 Simplified diagram of the tree-model



Conclusions

The decision-tree is a useful tool to structure decisions on control of BRC. Although the tree-model considered results simplify related to complexity of BRC data show that when BRC is nearly eradicated the best strategy is isolation and retest of reactors.

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