USE OF QUANTITATIVE RISK ANALYSIS TO DESIGN THE SWINE VESICULAR DISEASE ERADICATION PROGRAM IN ITALY

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In veterinary medicine Quantitative Risk Assessment (QRA) has been used in microbial food safety [3, 4] and import-export of live animals and animal products [1, 2]. There are very few cases in literature where this method has been used as a tool to choose control strategies. In the early '90s, Italy experienced a SVD epidemic and an eradication program was implemented in 1994, followed by a surveillance program in 1996. But in 1998 a new SVD epidemic occurred. Therefore, it was decided to start a new eradication program. The strategy of the new program was based on a QRA. Aim of this paper is to describe the QRA performed and the results obtained.

Materials & methods

A QRA was carried out in order to choose the best testing strategy for the identification of serologically positive herds. Six different scenarios were compared. The structure of the six scenarios was as follows: **1st scenario**: a stratified sample survey in each Region (stratification variable: breeding vs. fattening herds) able to detect 1% positive herds (HPR) with 95% of confidence (CL); in sampled herds, selection of a sample of pigs able to detect 22% positive animals (APR) with 95% CL; **2nd scenario**: like the 1st scenario but with a sample of pigs within herds able to detect 5% APR with 95% CL; **3rd scenario**: testing of all breeding herds in all Regions; in each herd, selection of a sample of pigs able to detect 22% APR with 95% CL, no testing of fattening stock; **4th scenario**: like the 3rd scenario but with a sample of pigs within herds able to detect 5% APR with 95% CL, this scenario is similar to the 1994 eradication program; **5th scenario**: similar to the 3rd scenario, but enclosing fattening stock as well, serological testing of 60000 slaughtered fattening pigs, stratified by Region and trace back of slaughtered positive pigs; **6th scenario**: herd testing based on the prevalence of serologically positive herds and the number of notified outbreaks in each Region so that: (a) in high risk Regions, a program similar to the 4th scenario; (b) in low risk Regions: a program similar to the 3rd scenario; in addition, 6th scenario included serological testing of 60,000 slaughtered fattening pigs, stratified by Region, from all Regions and trace back of slaughtered positive pigs. Data used in the model are derived from the surveillance programs performed in each Region during 1997 and 1998; sensitivity of ELISA test is from published data.

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The model consisted in two modules: in the first module (Table 1) the probability to detect an infected herd was estimated, based on scenario assumptions and herd size; in the second one (Table 2) the probability estimated in the first module was used as input to estimate the expected number of detected and undetected infected herds. The six scenarios were compared and analysed through a Monte Carlo simulation model [5], running 10,000 iteration in @Risk® software.

Results & Discussion

The results of the simulation model for the 6 scenarios are shown in Figure 1.
The simulation performed allowed the Italian government to choose the most cost effective strategy. Results of simulations point out that: i) effectiveness of strategies based on sample testing of herds (scenarios 1 and 2) is unfit for eradication since the number of undetected positive herds exceeds the number of detected ones; ii) strategies non-inclusive of fattening animals (scenarios 3 and 4) are able to detect a number of positive herds significantly lower than strategies inclusive of fattening animals (scenarios 5 and 6); iii) strategies 5 and 6 produce very similar outcomes (expected numbers of undetected positive herds 51 vs. 54; 95th percentiles 73 vs. 78) but at very different costs (1.026.430 EUR vs. 412.051 EUR). Therefore the 6th strategy was the most cost-effective and was then chosen by the Italian government. Results obtained show that QRA can be a useful tool to choose control strategies. Furthermore, the estimate of the expected number of undetected outbreaks is an input variable of paramount importance for import risk assessment, so the approach used can be applied to import risk assessment as well.

References

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TABLE 1: First simulation to estimate the probability of detection of infected herds

M= mean value of within-herd-prevalence at surveillance programs 1997-1998 – for each region							
S= standard deviation of within-herd-prevalence							
A Region	B Herd Size	C Morbidity	D Infected in the herd	E Tested pigs	F Infected in the sample	G ⊕ ves in the sample.	H Detected
∀ region	∀ class	Tnormal (M;S;0;1)	Binomial (B;C)	According to scenario	Hypergeo (E;D;B)	Binomial (F; sensitivity)	If (G>0;1;0)

TABLE 2: second simulation to estimate the number of detected/undetected infected herds

X= tested herds during surveillance programs 1997-1998 – for each region								
Y= positive herds in surveillance programs 1997-1998 – for each region								
A Region	B No. of herds	C Tested herds	D Prevalence of infected herds	E Infected herds in the population	F Infected herds in the sample	G Probability to detect infected	H Number of detected ⊕ ves	I Undetected ⊕ ves
∀ region	∀ class	According to scenario	Beta (Y+1; X-Y+1)	Binomial (C;D)	Hypergeo (C;E;B)	H value of table 1	Binomial (F;G)	E-H

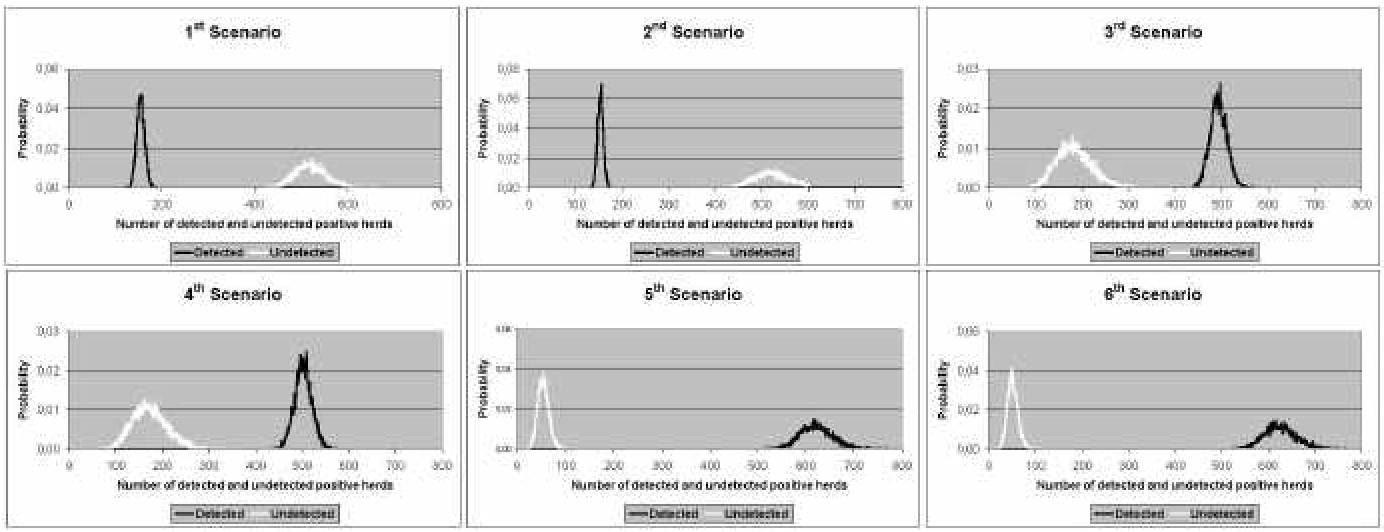

Figure 1: results of the six scenarios