Oral presentation by J.A. Backer during VEEC conference, December 2007, Wageningen.

VACCINATION AGAINST CLASSICAL SWINE FEVER: EPIDEMIOLOGICAL CONSEQUENCES

J.A. Backer[1], T.J. Hagenaars[1], B. Engel[1], M.C.M. de Jong[2], H.J.W. van Roermund[1]

[1]: Department of Quantitative Veterinary Epidemiology, Division of Infectious Diseases, Animal Sciences Group Wageningen UR, P.O. Box 65, 8200 AB Lelystad, The Netherlands
[2]: Department of Quantitative Veterinary Epidemiology, Wageningen UR, P.O. Box 338, 6700 AH Wageningen, The Netherlands

1. INTRODUCTION

Emergency vaccination will possibly be used in controlling a future outbreak of Classical Swine Fever (CSF) in the Netherlands (see 'Concept Beleidsdraaiboek Klassieke Varkenspest' (Anonymous, 2005)). A marker vaccine is available that enables the distinction between infected vaccinated animals and noninfected vaccinated animals. However, concerns exist that animals are only slowly protected by this type of vaccination and they may be infected subclinically. Using mathematical modelling, this research project (Bergevoet et al., 2007) will address two questions:

- Which emergency vaccination strategies can effectively be applied to control CSF epidemics?
- How can we declare areas free of infection and do emergency vaccination strategies increase the risks encountered in declaring freedom of infection?

2. MATERIALS AND METHODS

We developed a mathematical model that describes the effects of marker vaccination and transmission of CSF virus between individual animals, between pens and between farms. The results of transmission experiments and the outbreak data of the CSF epidemic that occurred in the Netherlands in 1997 and 1998, serve to calibrate the multi-level model. We applied this model on the situation of 2006, with in total 9000 pig farms. Distinctions were made between finisher farms (consisting only of finishing pigs), and multiplier farms (consisting of separate sow and piglet sections). Different control strategies were compared: three emergency vaccination strategies (in 1 km, 2 km and 5 km rings) and preemptive ring culling in 1 km radius around a detected herd. Thousand simulations were carried out for each control strategy. The resulting simulated epidemics were subjected to six end screening scenarios that differ in the number of animals sampled per farm type.

3. RESULTS

In Table 1 results are summarized for outbreaks that occurred mainly in pig farm dense areas in the Netherlands and that were controlled using different control strategies. As a measure for the effectivity of a control strategy, the outbreak size, the duration and the effective reproduction number between herds R_h of the simulated epidemics are evaluated.

Table 1 Results for outbreaks which have started with 11-20 infectious herds at the moment of the first detection of an infected herd (between brackets the two-sided 95% interval).

control strategy	number of detected herds	number of not detected herds	duration (days)	R_h*
1 km ring culling	18 (9-57)	0 (0-1)	92 (36-278)	0.49 (0.08-1.22)
1 km ring vaccination	22 (9-84)	1 (1-9)	111 (36-313)	0.53 (0.09-1.30)
2 km ring vaccination	19 (9-49)	2 (2-8)	95 (36-233)	0.46 (0.08-1.08)
5 km ring vaccination	15 (8-29)	2 (2-8)	71 (34-171)	0.35 (0.05-0.84)

* The effective reproduction number between herds R_h is here defined for 'second generation herds': this is the number of infections that is caused by a herd that was infected by a herd that was infectious at the moment of the first detection of an infected herd.

The results show that 1 km ring vaccination is less effective than 1 km ring culling. This is not surprising as it takes some time for vaccination to build protection (typically two weeks), whereas culling works instantaneoulsy. The effectiveness of vaccination in 2 km radius around an infected herd is comparable to 1 km ring culling. The most effective strategy is 5 km ring vaccination, which yields an effective reproduction number significantly below unity.

Vaccination increases the chance that a within-farm outbreak remains undetected during the epidemic, because more small outbreaks occur on vaccinated farms that were infected before the vaccine gave full protection. The number of these undetected outbreaks increases with increasing vaccination radius, compared to the total epidemic size. After the epidemic they need to be detected during the end screening to prevent them entering the food chain. The chance that they also escape detection during the end screening depends on the sample sizes taken on the different type of farms (finishers, sows or piglets and vaccinated or unvaccinated).

The recommended end screening scenario is to sample 1 animal per pen on all vaccinated farms, 1 animal per pen on unvaccinated finisher farms and a random sample as required by the EU for unvaccinated multiplier farms (i.e. 32 piglets and 61 sows). Using this scenario, the absolute number of seropositive animals which are missed by the end screening is on average 3-5 animals in the entire country, with an upper boundary of 10-18 animals (95% quantile). Applying more stringent end screening scenarios (e.g. sampling 2 animals per pen instead of 1) can't lower these numbers much. The most important result however, is that the risk of missing infected animals during the end screening is not different for preemptive culling or emergency vaccination strategies.

4. DISCUSSION

In conclusion, emergency vaccination can be as effective a control strategy as pre-emptive culling to control CSF epidemics, provided that a larger vaccination radius is used. However, it is to be expected that the end screening will detect a number of small outbreaks on vaccinated farms, which would set back the infection free status. Therefore it is recommendable to start with (intermediate) screenings as soon as seems acceptable. When a sufficiently stringent end screening scenario is used, vaccination does not increase the risk of missing seropositive animals.

The simulation results have also been used by LEI for the economical analysis. They concluded that the largest part of the losses is caused by the decreased revenues of animals slaughtered due to welfare problems, and not the decreased value of meat of vaccinated animals. The extent of these problems depends on duration of the outbreak and the size of the area with movement restrictions.

5. REFERENCES

Anonymous, *Concept beleidsdraaiboek klassieke varkenspest.* Report from Ministry of Agriculture, Nature Management and Fisheries, versie 2.0, december 2005.

Bergevoet RHM, Backer JA, Kroon, SMA van der, Hagenaars TJ, Baltussen WHM, Engel B, Hoste R, Jong MCM de, Backus GBC, Roermund HJW van; Vaccinatie bij varkenspest: epidemiologische en sociaaleconomische effecten, ISBN/EAN: 978-90-8615-168-4, LEI Rapport 5.07.06, ASG Rapport ASG07-IOO442, 2007, p.163.