Assessing outbreak-specific control strategies against FMD – A simulation approach

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Worldwide, the productive livestock industry depends on the health status of its animals. One of the greatest economic threats to this branch of production are highly contagious diseases – for example Foot and Mouth Disease (FMD). During the last outbreak in the UK in 2001, cases were reported on over 2000 farms, approximately 6 million animals had to be slaughtered, and the cost of the outbreak was estimated as 8 billion Euros\(^3\).

In late March 2001, the British Government decided to implement the following control strategies: slaughter of animals on infected farms within 24 hours, and within 48 hours on contiguous farms. In one part of the country (notably Cumbria, and the adjacent county of Dumfries & Galloway in Scotland), compulsory slaughter of all sheep within a 3-km radius of infected holdings in defined areas was undertaken because of concerns that extensive disease in sheep might pose a threat to dairy and beef cattle in the area.\(^4\) Although discussed early on, emergency vaccination was not performed for various reasons.

As a consequence of the UK epidemic alternative contingency plans should be considered and evaluated during “peace time”. The Swiss Veterinary Office in collaboration with the IVI invited several Swiss organisations and stakeholders to discuss the use of prophylactic vaccination and the possible reaction of consumers towards the marketing of meat and meat products originating from vaccinated animals. One of the main conclusions from this “round table discussion” was that an emergency protective vaccination strategy, in addition to stamping out of FMD infected herds, was preferred by all organisations.\(^3\)

Based on the conclusions of this meeting it is obvious that alternative control strategies to the mass slaughter of animals have to be considered. So far, in Switzerland there is no defined strategy for the implementation of vaccination and other strategies alternative to stamping out. Therefore, different outbreak scenarios are needed to evaluate the impact of strategies and to assess their benefit. To approach this task, we are using a computer model to simulate the spread of FMD in different outbreak scenarios and to quantify the effects of different control strategies. On the basis of the output of the different scenarios recommendations in respect of control measures can be derived and eventually implemented in case of emergency. The simulation model we are using is called InterSpread Plus (ISP) and was developed by Massey University in Palmerston North, New Zealand. A pre-cursor of ISP was used in the assessment of vaccination in the UK outbreak.

ISP is a stochastic, spatio-temporal computer simulation model for infectious diseases in farm animals. The program creates a virtual population based on data provided (i.e. number and geographical locations of the farms, species and their respective numbers on each farm). The initial infection is randomly assigned to one or more of these farms and the model then calculates the spread of disease on a daily basis taking account of the following spread mechanisms:
- spread through movement (animals, persons and vehicles)
- airborne spread
- local spread
- dairy tanker routes

Additionally, these mechanisms are influenced by several other pre-defined parameters.

ISP requires a variety of input data from many different sources. This information had to be collected prior to running the simulations. Part of this information could be extracted from existing animal databases such as the Swiss agrarian-political information system (AGIS) and the animal movement database (TVD). Additional data was gathered by an extensive screening of scientific publications. In the case where no written information was available, we relied on expert opinion.

Final results of the simulation are not yet available. First, a baseline scenario was defined reflecting the eradication strategy lined out in the current Swiss legislation. This contingency plan included the following measures:

- depopulation of infected herds
- movement ban of all farmed livestock throughout Switzerland during at least a 7 day period
- the establishment of protection and surveillance zones, with a radius of 3 km and 10 km respectively, around infected premises. All farms within these zones will be put under surveillance and movement restrictions will apply
- forward and backward tracing of dangerous contacts and surveillance of these contact farms

The efficiency of the different control strategies can be evaluated during the course of the modelled epidemic. It is possible to specifically apply the strategies spatially, as well as temporally, differentiated. The extent of an outbreak occurring either in a sparsely or a densely populated area will be compared. Further, we’d like to examine the effect of the species infected on the index farm – cattle vs. swine vs. sheep – on the course of the epidemic. Based on these scenarios other control strategies such as pre-emptive culling of dangerous contact farms, the pre-emptive culling of premises lying within a defined radius to an infected herd, and different vaccination strategies (mass prophylactic vaccination vs. ring vaccination) will be evaluated either as a single measure or in combination to other strategies. From the final output of these simulations we will provide the authorities with the necessary base information on how to best deal with a specific outbreak and to minimize financial as well as animal losses.

This presentation will be a synopsis of our preliminary results and an outlook on future work.

References

i WOOLHOUSE, M.E.J. (2001) Epidemiology and control of FMD in the UK. Dutch Society for Veterinary Epidemiology and Economics