Impact of herd density on spread and control of FMD epidemics in The Netherlands

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Summary

The influence of area characteristics on the consequences of various foot and mouth disease control strategies was studied for the Dutch situation using the spatial, stochastic simulation model, InterFMD. The regular EU control measures served as the base scenario for comparative evaluations. The alternative scenarios included additional measures such as a complete national restriction on animal movements at the start of the epidemic, pre-emptive slaughter and destruction of contiguous herds and suppressive vaccination of contiguous herds. The epidemiological impact of the additional control measures was studied for epidemics starting in a densely populated area as well as for epidemics commencing in a sparsely populated area.

Introduction

The usual measures adopted by the EU member states to control outbreaks of foot and mouth disease (FMD) are based on the strategy of destruction of infected herds with appropriate disposal of potentially infective material (stamping out) and control of the movements of live animals, animal products, persons, vehicles and any other substance liable to transmit the virus. It has been postulated that such a strategy may not be sufficient to eradicate the virus, especially when the epidemic takes place in an area with a high density of susceptible animals.

Selection of an inadequate control strategy could cause large additional economic losses, while delayed implementation of additional control measures could cause extensive spread of the disease (Tomassen et al, 2002). In the case of an FMD outbreak, animal health authorities have to make disease control decisions under intense time pressures. A priori analyses of various disease control options by means of computer simulations could provide decision makers with some supporting guidelines.

In this simulation study, the possibility of defining ‘area specific rules of thumb’ was evaluated for the Dutch situation.

Material and methods

The influence of herd density on the consequences of various foot and mouth disease control strategies was studied for the Dutch situation using the spatial, stochastic simulation model, InterFMD (Mourits et al., 2002). The regular EU control

measures served as the base scenario for comparative evaluations. The alternative scenarios included additional measures as a complete national restriction on animal movements of 72 hours at the start of the epidemic (72MSS), pre-emptive slaughter and destruction of contiguous herds within a radius of 1 or 2 km (PRE_1km or PRE_2km) and suppressive vaccination of contiguous herds within a radius of 1, 2 or 4 km (Vac_1km, Vac_2km or Vac_4km). Implementation of control measures was restricted by the limited amount of available resources to kill and destroy or to vaccinate animals. The epidemiological impact of the control measures was studied by the variation in size and duration of the simulated epidemics for epidemics starting in various densely populated areas (DPLA; density > 1000 FMD susceptible herds in 10 km radius) as well as for epidemics commencing in various sparsely populated areas (SPLA; density < 250 FMD susceptible herds in a 10 km radius).

Results

Simulation results demonstrated that the regular EU policy alone is a rather risky policy to control a FMD epidemic in the Netherlands; application of the basic EU control measures resulted in a considerable number of large epidemics. Even when the epidemic was initiated in a SPLA, there was still a risk for extreme outbreaks. These extreme outbreaks occurred as a result of spread towards a DPLA, resulting in an epidemic with the characteristics of an epidemic that was initiated in a DPLA.

Implementation of the 72MSS measure resulted in the SPLA in a reduced risk for large epidemics. This effect was not apparent in the DPLA. At the moment of first detection (=start of 72MSS), the number of infected farms present was lower in the SPLA than in the DPLA. Prevention of spread by tracing the source or secondary outbreaks from the first detected farm during those 72 hours of MSS was therefore more effective in the SPLA than in the DPLA.

Independent of herd density, the EU policy in combination with PRE_1km turned out to be a very effective control strategy. Application of the VAC_2km measure was at least as effective as the PRE_1km addition. Enlargement of the radius in which neighbouring farms were pre- emptively slaughtered or vaccinated (i.e. PRE_2km or VAC_4km) was – especially in the DPLA - less efficient in controlling the disease due to limitations in available resources.

Discussion

In this simulation study, only the epidemiological effects of the control strategies were considered. Tomassen et al. (2003) used the simulated epidemiological results to evaluate the economic consequences of the various control strategies. In general, the economic consequences of a FMD epidemic are strongly correlated with the duration of the epidemic and, for exporting countries, the duration of the imposed export bans.

Based on the results it can be concluded that – in case of a FMD epidemic in the Netherlands - control measures should be made area specific (i.e. according to the herd density of the detected areas) to optimize the efficiency of the control strategy.

However it will be difficult to define a uniform density unit that can be used as a general rule of thumb. Density figures based on number of susceptible herds within a radius of 10 km, for instance, do not reflect the presence of farm clusters. Due to the heterogeneous distribution of herds within an area, the interpretation of such a density figure could result - in some cases - in a serious underestimation and in other situations in an overestimation of the expected 'density risk', i.e. risk of local spread. On the other hand, density figures based on a smaller radius would provide more insight in the risk of local spread but at the expense of a loss in information on, for instance, the number of farms involved in movement restriction zones. Such information would be needed to estimate the extent of the afflicted production capacity or, in other words, to make a sound estimation of the potential economic risks.

The consequences (epidemiological as well as economic) of various control strategies should therefore be evaluated for each specific region separately. The simulation model InterFMD could serve as an effective tool to support these regional explorations.

References

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