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Control options for Foot-and-Mouth Disease in a highly densely livestock-populated area in Germany

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Introduction

Foot-and-mouth disease (FMD) is an animal disease of cloven-hoofed animals with massive economic consequences. The last outbreak in Germany was in 1988. However, there is a constant risk of introduction into EU member states. Control measures in the event of FMD include inter alia depopulation and emergency vaccination of cloven-hoofed animals. In addition to sanitary issues and economics, animal welfare aspects play a role when control measures are chosen. The objectives of this study were to evaluate different control strategies for FMD with respect to their effect on the duration of the epidemic and the number of animals to be culled compared between areas with high versus medium livestock density.

Methods

A stochastic simulation model (DADS), which was originally adapted and applied to Denmark, was modified to take the conditions of Lower Saxony into account, the most densely livestock-populated area within Germany. Fourteen different control scenarios were compared between the following two regions of Lower Saxony: In the East 0.6 farms/km^2 and around 70 cloven-hoofed animals/km^2 were present, while in the West 1.4 farms/km^2 and 470 animals/km^2 respectively.

The model is a spatial, stochastic, state-transition model on animal level with time steps of 1 day. It is written in R. The model was run for 200 simulations per scenario.

Data on farms include production type, geographical location, species, age and number of animals.

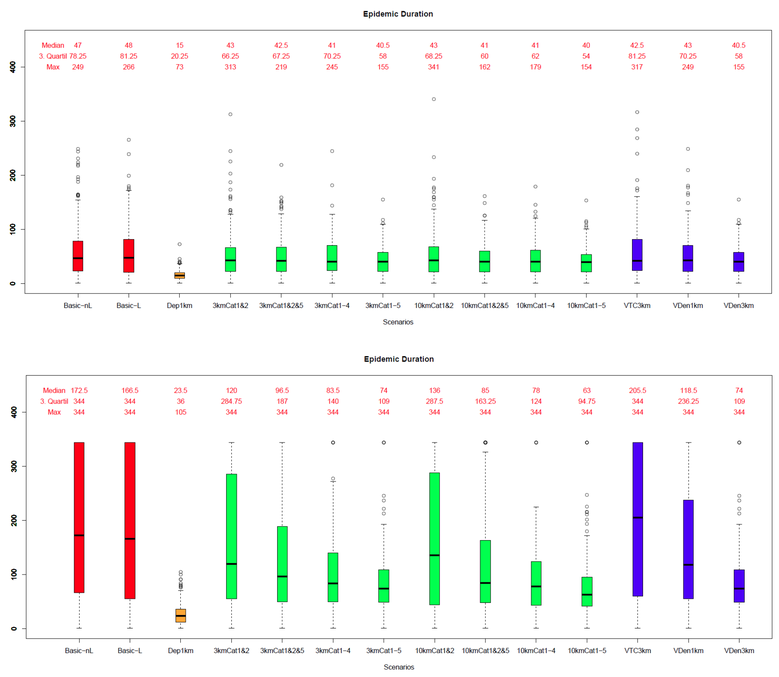
Probabilities for transmissions for different pathways: animal transport, veterinarians, milk tankers and other contacts.

The following control scenarios were investigated:

- Basic (culling in the affected farm, restriction zones) with and without resource limits (personnel, rendering etc.)
- Depopulation within the 1 km zone
- Vaccination to live (different species and zones)
- Vaccination to cull (different species and zones)

Results

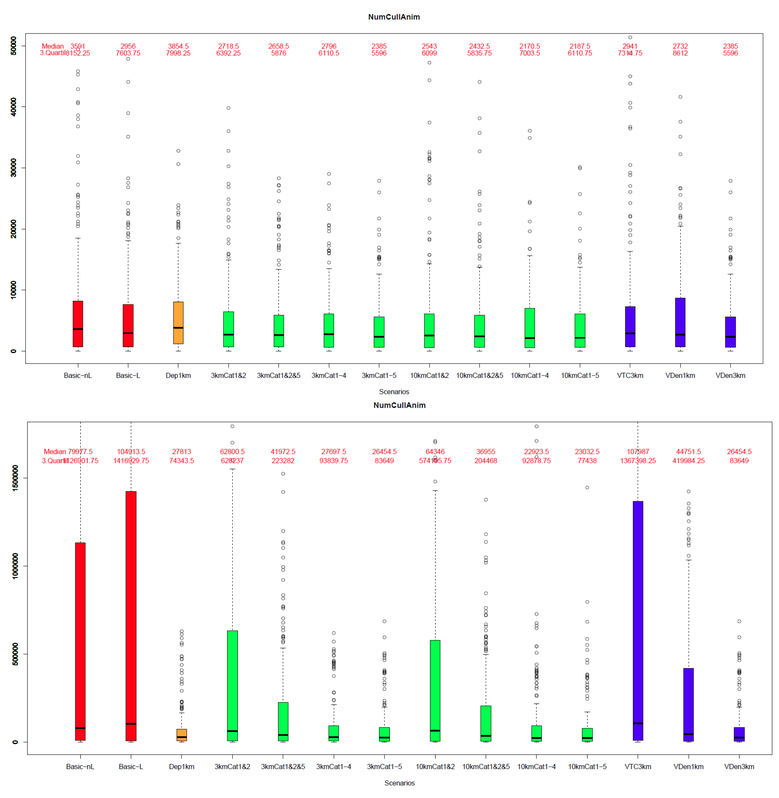
Figure 1. Duration of an FMD epidemic in simulated FMD-outbreaks in areas with medium or high livestock density.



Medium density: 70 cloven-hoofed animals per km^2

High density: 470 cloven-hoofed animals per km^2

Figure 2: Number of culled animals in the simulated FMD-outbreaks in areas with medium or high livestock density.



Medium density: 70 cloven-hoofed animals per km^2

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Discussion and Conclusions

The results obtained in the simulation model were similar for most control scenarios. However, there were differences between the two areas in the duration of the epidemic and in the numbers of culled animals. In areas with medium livestock population, depopulation was always the best control strategy. In areas with high livestock density, emergency vaccination, both without and with subsequent culling, resulted in a similar or even smaller proportion of animals to be culled as compared to depopulation.

Depopulation and emergency vaccination represent efficient tools to control FMD outbreaks in the studied regions in Germany. Especially in areas with a high livestock population, emergency vaccination of cattle and pigs (with or without sheep and goats) is an alternative for depopulation. This might also have positive effects on the resource availability in these regions. Thus, the selection of the control strategy depends on the livestock density, but also on several other factors, including the societal acceptance of particular control options, early diagnosis and pre-defined control scenarios that can be rapidly implemented in the case of an outbreak.

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