DTU Vet
National Veterinary Institute, Technical University of Denmark

Anette Boklund[1*], Lasse Engbo Christiansen[2], Tariq Halasa[1], Claes Enøe[1]

Background and objectives:

Several studies have compared control strategies for FMD in different countries. However, farm sizes and densities are changing all over Europe. Our objectives were to investigate how farms would change in size and types over the next 20 years and how previously predicted control strategies would change with times in terms of size, duration and costs.

Materials and methods

1. Projection of herd sizes and types

Based on data from 1999-2010, we created a transition probability matrix allowing herds to change in size and type for seven regions of Denmark.

Projection of opening of new herds was based on a log-linear regression model for each region and species.

All herds that changed size category had their number of animals sampled among all herds that were in that size category. The upper limit of the largest herd category was based on expert opinion.

2. Model and data

The stochastic simulation model DTU-DADS was used to simulate the spread of FMD in Denmark.

Data on farm level including farm location, type (cattle, swine, sheep and goat), number of animals and animal movements were used[a].

All input parameters, epidemiologic as well as economic, were kept constant, except low risk contacts (*visitors – not professionals, rendering trucks, feed trucks, milk tanker routes, transport of animals to slaughter)*, which were increased by 50%.

3- Control scenarios

Three combinations of control measures were run:

I- A basic scenario including depopulation of detected herds, 3 km protection and 10 km surveillance zones, movements tracing, and 3 days national standstill.

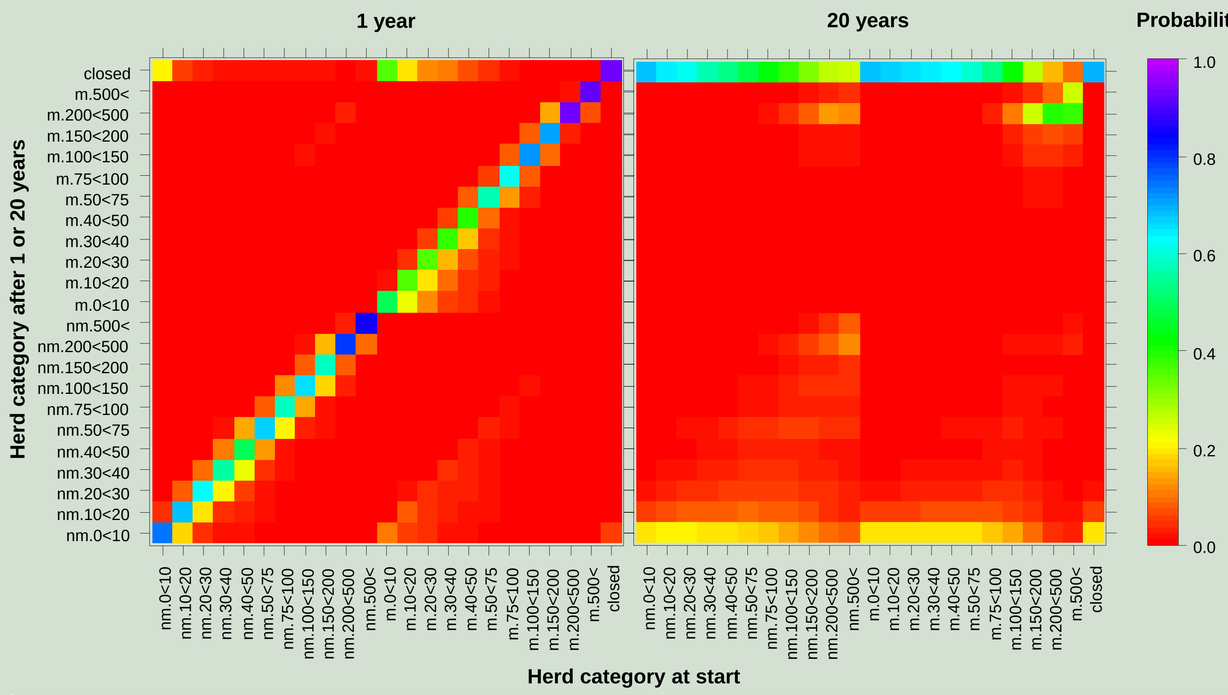
II- Basic scenario plus depopulation of herds within 1 km radius around detected herds (Depop).

III- Basic scenario plus vaccination within 1 km radius around detected herds. Vaccination was simulated in a vaccine-to-cull (VTC) or a vaccine-to-live (VTL) scenario.

Depopulation and vaccination were started when 10 herds were detected and continued to the end of the epidemic. These scenarios were compared for year 2007 (original farm file) and year 2030 (projected farm file, regarding herd size and type).

Results:

Transition probability matrix for cattle



Predictions of herd sizes

Predictions of how cattle herd sizes will change in Denmark after 1 or 20 years.

m = milking

nm = not milking

Epidemiologic and economic consequences of an FMD outbreak in Denmark now and in the future

- using 4 different control strategies, when epidemic started in cattle herds located in high density cattle areas.
- Results are presented as the median with 5th and 95th percentiles. In the VTC scenario, vaccinated herds are assumed to be culled after the outbreak.

Control scenario – Extra control measures added after 10 herds are detected and applied in 1 km ring zones	**Epidemic duration (days)[b]**		**Number of infected herds**		**Total costs and losses (10^6€)**	
	Current (2007)	**Prediction (2030)**	Current (2007)	**Prediction (2030)**	Current (2007)	**Prediction (2030)**
Basic	56 (16-142)	**43 (16-344)**	67 (13-245)	**55 (11-171)**	565 (402-946)	**539 (409-1412)**
Depop	35 (14-75)	**35 (15-93)**	45 (12-128)	**48 (11-132)**	493 (399-684)	**523 (409-834)**
VacToCull (VTC)	42 (16-90)	**40 (15-344)**	56 (13-154)	**51 (11-162)**	521 (409-724)	**535 (408-1412)**
VacToLive (VTL)	43 (15-88)	**39 (14-344)**	55 (11-158)	**51 (10-159)**	599 (477-806)	**608 (485-1510)**

[b] Duration is calculated as time from first detection to last cull

Conclusions:

Herds are predicted to increase in size or close down over the next 20 years.

In most cases, epidemics managed with the basic control strategy are predicted to be smaller, of shorter duration and less costly in 2030 compared to 2007.

Epidemic managed by other strategies are predicted to be more costly in 2030 than 2007. However, the model predictions still rank the efficiency of the control strategy in the same way.

[*] email: anebo@vet.dtu.dk

[1] National Veterinary Institute, Technical University of Denmark (DTU), Denmark.
[2] Department of Applied Mathematics and Computer Science, Technical University of Denmark (DTU), Denmark

[a] Boklund et al., Preventive Veterinary Medicine , In Press