DTU Vet
National Veterinary Institute

How to handle an outbreak of foot-and-mouth disease in Denmark

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

Background and objectives:

The recent outbreaks of foot and mouth disease (**FMD**) in western Europe pointed out the need for assessment of control strategies to optimize the control of FMD spread in a country. Our objectives were to assess the epidemiologic and economic consequences of a hypothetical FMD outbreak in Denmark and the consequences of using ring depopulation or emergency vaccination to control the outbreak.

Procedures:

1- Model and data

The Davis Animal Disease Simulation model was adapted 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.

2- Disease spread

A herd may obtain infection throughout direct animal movements, medium risk contacts (veterinarians, artificial inseminators or milk controllers), low risk contacts (feedstuff and rendering trucks, technicians or visitors), market contacts, abattoir trucks, milk tanks, or local area spread. The epidemic was initiated in a high density cattle area. Thousand index herds were randomly selected to initiate disease spread; one herd per iteration.

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 0.5 km radius around detected herds (**Depop**).

III- Basic scenario plus vaccination within 1 km radius around a detected herd. Vaccination was simulated in a vaccine-to-kill (**VTK**) or a vaccine-to-live (**VTL**) scenario.

Depopulation and vaccination were applied either 14 days after the first infected herd was detected or after detection of 20 infected herds. The costs were calculated as direct costs and export losses. The spatial spread of the outbreak was calculated using the convex hull method.

Results:

VTL following detection of 20 infected herds resulted in the shortest epidemic duration and a small number of infected herds. However, the large associated economic damage makes the ring depopulation scenarios the cheapest strategy for Denmark to handle an FMD outbreak starting in a high density cattle area.

Epidemiologic and economic consequences of an FMD outbreak in Denmark using 7 different control scenarios. Results are presented as median, 5th and 95th percentiles. In the VTK scenarios, vaccinated herds will eventually be culled.

Control scenario	Epidemic duration (days)	Number of infected herds	Number of depopulated herds	Number of Vaccinated herds	Size of infected area (1000 km²)	Direct costs (million €)	Export losses (million €)
Basic	56 (16-142)	67 (13-245)	67 (13-245)	0	10 (0.6-29)	39 (11-138)	523 (390-820)
Depop-14 days	46 (16-100)	59 (12-177)	84 (13-282)	0	9 (0.5-25)	35 (11-103)	497 (390-683)
Depop-20 herds	44 (16-99)	**56 (13-163)**	91(13-293)	0	9 (0.6-25)	**34 (11-94)**	**490 (389-670)**
VTK-14 days	46 (18-95)	66 (8-184)	66 (8-184)	98 (5-366)	9 (0.8-25)	37 (11-103)	503 (400-675)
VTK-20 herds	47 (18-94)	65 (13-163)	65 (13-163)	133 (0-406)	10 (0.7-24)	37 (12-90)	505 (400-661)
VTL-14 days	46 (16-96)	63 (12-185)	63 (12-185)	88 (4-351)	**9 (0.5-24)**	37 (11-108)	576 (473-753)
VTL-20 herds	**42 (16-90)**	58 (12-167)	**58 (12-167)**	116 (0-430)	**9 (0.5-24)**	35 (11-103)	566 (468-734)

Conclusions:

- **An outbreak of FMD in Denmark would result in a large economic damage to the Danish agricultural sector.**
- **Export losses represent the major part of the economic damage.**
- **Ring depopulation of herds around detected herds seems to be the cheapest strategy to handle an FMD outbreak started in a high density cattle area.**

* tahbh@vet.dtu.dk

[1] National Veterinary Institute, [2] Department of Informatics and Mathematical Modeling, Denmark's Technical University (DTU), Denmark.