Evaluation of the impacts of 'time to detection' of a **foot-and-mouth disease incursion** in Central Europe using EuFMDiS modelling tool

eufmd
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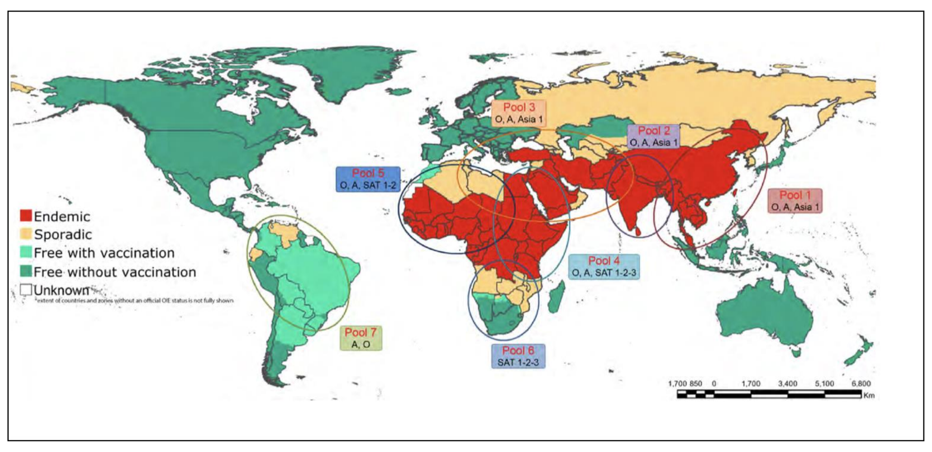
MAIN MESSAGE

- **The objective** was to compare the impacts of the time to detection of a foot-and-mouth disease (FMD) incursion in Central Europe using the European Foot-and-Mouth Disease Spread Model (EuFMDiS).
- Early detection reduced the epidemic size, length, and economic losses significantly, regardless of the control measures selected.
- Stamping out along with ring culling in 1km radius of infected farms were highly effective; animal welfare was not considered in the model.
- The median number of affected countries ranged from 2 to 3 depending on the model scenarios and control measures.

INTRODUCTION

Figure 1: Global distribution of FMD virus serotypes (King et al., 2017)



From 1985 to 2006, there were 37 FMD outbreaks in Europe in 14 countries.

Latest FMD outbreak in Europe:

- Bulgaria
- Notified to OIE on 5 Jan 2011
- 2230 animals were culled

Table 1: Historical FMD outbreaks in free countries

Outbreaks	Economic losses (US $ millions)	Number of infected farms	Number of slaughtered animals (millions)	Outbreak duration (days)	Time to detection (days)
1997 Taiwan	6617	6147	4	132	21
2001 Uruguay	700	2057	0.02	120	7
2001 UK	9204	2030	6.24	214	24
2010 Japan	>550	292	0.29	76	30
2010/11 Korea	>2780	3748	3.47	145	15

METHODS

EuFMDiS, which is a multi-country foot-and-mouth disease outbreak simulation model, was used to simulate an FMD outbreak in four central European countries (Austria, Croatia, Hungary, and Slovenia).

EuFMDiS has three core components:

Livestock population: Geolocation, herd size, and herd types.
FMD spread: Direct and indirect contacts, local and airborne spread.
FMD control: Movement restriction, stamping out, ring culling, vaccination, etc.

Table 2: Description of the model scenarios

Scenarios	Time to detection (TTD) (days)	Control measures
1 to 3	14, 21, 28	Stamping out (SO): Culled infected farms only.
4 to 6	14, 21, 28	SO and ring culling in 1km radial zone (SO_RC): SO of infected farms plus culled susceptible farms in 1km radial zone.
7 to 10	14, 21, 28	SO and vaccination to retain (VR): Vaccination was done in 3km radial zone and vaccinated animals were allowed to live. Culled infected farms only.
11 to 13	14, 21, 28	SO and vaccination in 5km donut shape (VR_5): Vaccination was done in 5km donut shape area and vaccinated animals were allowed to live. Culled infected farms only.
13 to 15	14, 21, 28	SO and vaccination to waste (VW): Vaccination zone: 3km radius; culled both vaccinated and infected farms.

Susceptible animal population (herds):

- **Total 16 million (316442)**
- Austria: 5.3 million(106667)
- Croatia: 1.94 million (118583)
- Hungary: 7.85 million(50461)
- Slovenia: 0.87 million (40732)

Index herd characteristics:

- Large commercial beef
- Herd size: 121

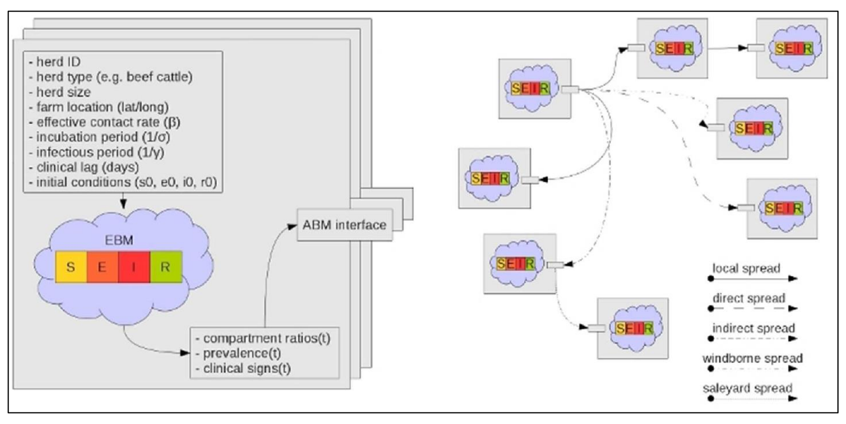


Figure 2: Equation-based model (EBM) for within-herd disease transmission and stochastic between-herd infection spread pathways (Ref: Bradhurst et al., 2015)

RESULTS

- The median number of countries impacted due to the simulated FMD outbreak in Central Europe ranged from 2 to 4 depending on the control measures and model scenarios.

Figure 3: Epidemic duration

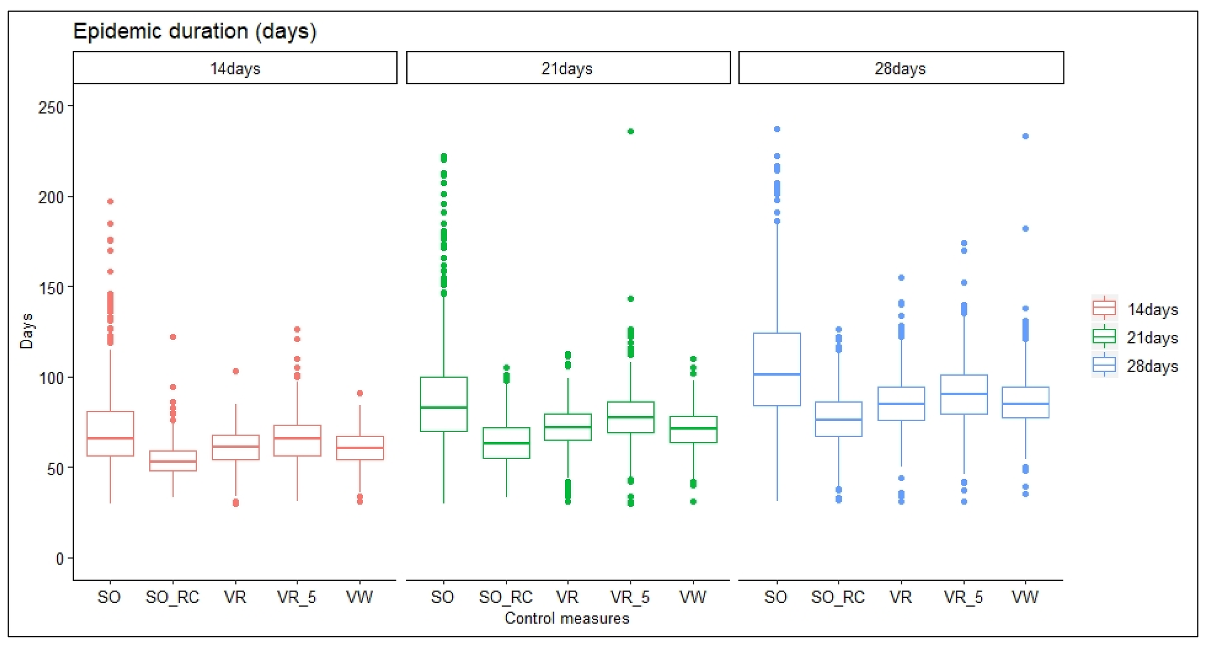


Figure 4: Number of infected herds

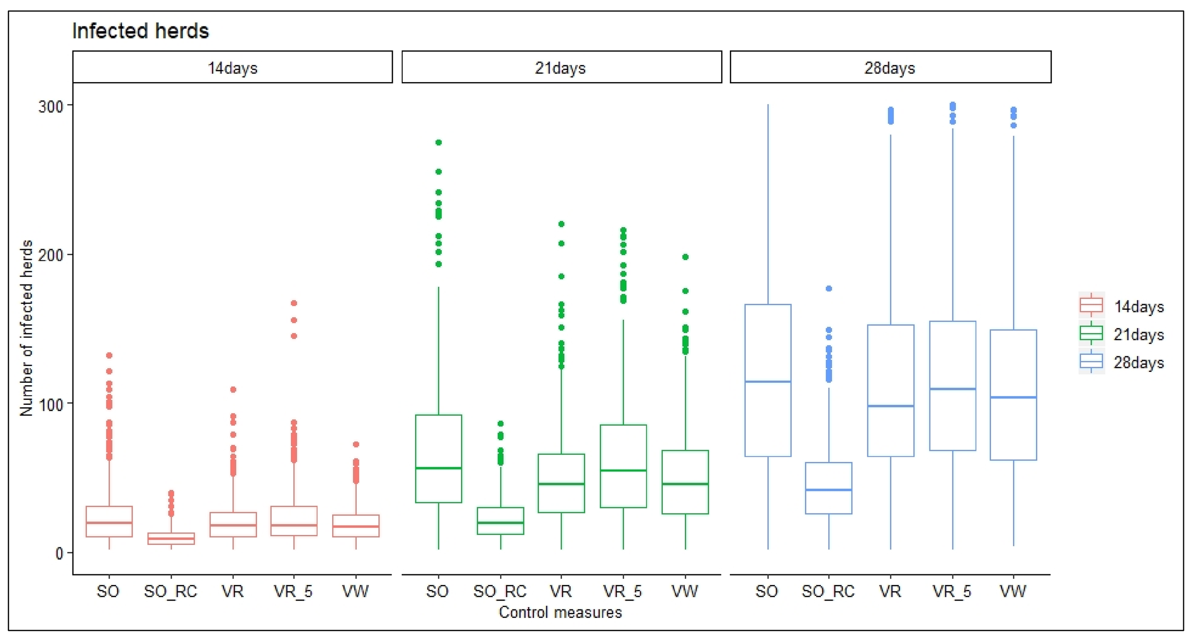


Table 3: Median (interquartile range) number of animals culled and costs incurred

Outcome	TTD	SO	SO_RC	VR	VR_5	VW
Total animals culled	14	605(348, 954)	3725 (2376, 5561)	551(320, 879)	578 (372, 960)	10634 (7680, 14749)
	21	1735 (1040, 3061)	7664 (4955, 11630)	1379 (762, 2159)	1717 (902, 2754)	19653 (13941, 27024)
	28	4126 (2064, 3060)	15743 (10286, 23272)	3386 (2036, 5329)	3686 (21799, 5987)	35250 (23472, 49378)
Total cost (Euro)	14	60.3 (50.9, 77.8)	49.9 (44.2, 57.8)	56.2 (48.9, 62.9)	60.2 (50.6, 67.2)	61.2 (53.5, 70.8)
	21	79 (64.4, 109)	63.3 (55.4, 81.6)	67.4 (59.0, 75.9)	71.7 (62.5, 86.2)	76.8 (68.6, 88.4)
	28	110.2 (91.4, 365)	82.3 (70.7, 146.8)	82.5 (70.7, 146.8)	90.6 (75.3, 404.6)	104.8 (83.9, 389.6)

CONCLUSIONS

- The study evaluated the epidemiologic and economic impacts of the multi-country spread of foot-and-mouth disease (FMD) in Europe using the EuFMDiS.
- The findings showed that an effective surveillance for early detection along with suitable control measures could significantly reduce the extent and cost of an outbreak.
- Stamping out along with the ring culling in 1km radius of infected farms was found to be an effective control measure, however, the animal welfare concern of ring culling was not evaluated in this model.

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