RESEARCH BRIEF: **Impact of potential changes to movement standstills on FMD risks in Scotland**

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1. KEY MESSAGE

Without allowing for exemptions to the standstill rule, a shorter standstill of 6-days, which is comparable to the standstill applied in England and Wales, is almost as effective as a long standstill period of 13-days. Our results indicate that a simpler biosecurity system would offer minimal additional risk for FMD.

2. MAJOR FINDINGS

Some livestock movements that are allowed to occur under current regulations might be disallowed under others, e.g. if standstill exemptions are discontinued. Also, some farmers might change their pattern of moving livestock if for example, standstill periods were reduced.

(1) Redirecting ("rewiring") of livestock movements via a set of simple rules and with standstill exemption prohibited, an analysis of epidemic size showed that this will reduce the probability of large outbreaks (Figure 2), with these outbreaks also reduced in spatial extent (Figure 3).
(2) Without exemptions, a shorter movement standstill (6-days) is almost as effective as a longer standstill period (13-days), indicating that a simpler system would present minimal additional risk for FMD (Figure 2).
(3) Our results suggest that explicitly manipulating the contact network structure in a sensible way has the potential to significantly impact disease control.

3. OBJECTIVES

Movement standstills were introduced after the 2001 foot-and-mouth (FMD) disease outbreak. They are known to be effective for limiting disease spread but commercial considerations result in pressures to relax them. We assessed how movement restrictions have influenced farmer behavior so far by analyzing three years of sheep and cattle movements in Scotland (2011 – 2013). This showed that approximately half of the movements taking place within the standstill period may have been breaching standstill regulations (Figure 1). These could be deliberate breaches or potentially resulting from farmer confusion over the existing rules and their exemptions. Changes to movement standstills however could change individual decision-making on when and where farmers sell their livestock, and thus will influence the risks of FMD associated with livestock movements. We investigated the possible consequences of changing durations of movement standstills (either 6-days or 13-days) and exemptions (allowing them or not) on the potential for FMD spread through Scotland via simulation and network analysis.

4. POLICY IMPLICATIONS

This research could inform a new policy, e.g. a review of the existing standstill policy and their exemptions. Nevertheless, the results also support the existing policy by showing that a long standstill of 13-days is effective, but exemptions do pose a risk for disease transmission.

5. METHODS

We used a combination of network measures and stochastic simulation to investigate the possible knock-on effects of changing durations of movement standstills and exemptions might have on a potential FMD epidemic in Scotland.

Modelling framework

The simulation disseminated FMD through direct farm-to-farm movements, via movements through markets, and via local spread. The model also contained control measures: (i) the examination of

dangerous contacts and (ii) culling of animals on confirmed premises. The transmission model was individual-based at the level of the holding, and generated infection stochastically while replaying recorded livestock movements. Infection was seeded at five farms that were known to have moved sheep onwards within three days after the start of the simulation and the disease was allowed to spread unrestrictedly for 20 days (broadly similar to the period for which FMD remained undetected in Scotland at the beginning of the 2001 UK outbreak). After this a national movement ban was imposed and infection could only spread locally. We assessed the effects on the simulated disease outbreaks through epidemic size and epidemic duration.

6. FIGURE AND TABLE

Figure 1:

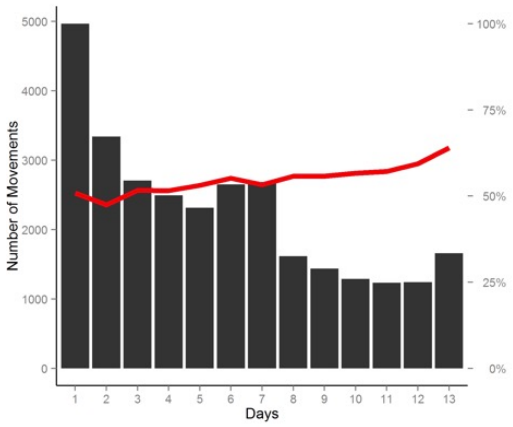

Figure 2:

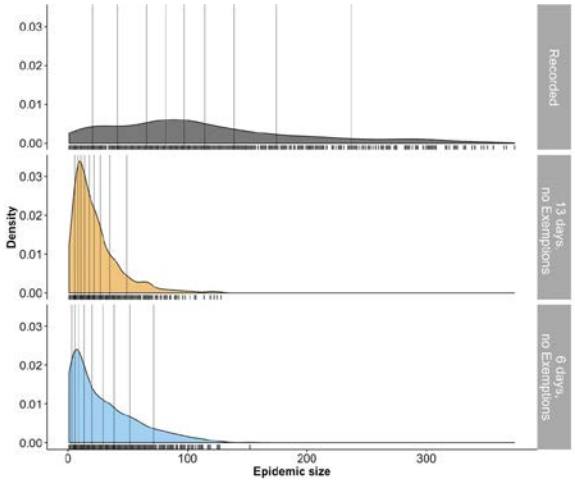

Figure 3:

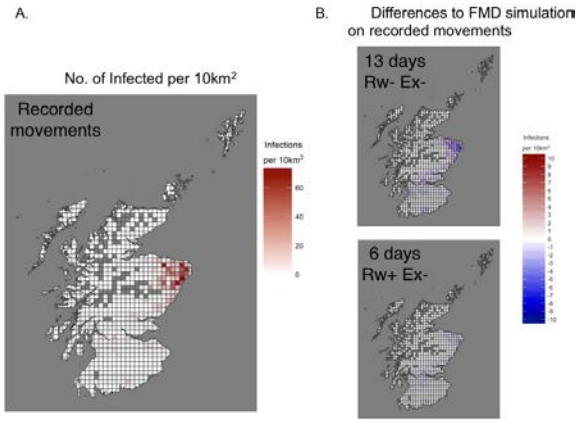

Figure 1. Movements (for years 2011-2013) occurring during the standstill period. Red line: proportion of movements that appear exempt (percentage scale on the right). **Figure 2.** FMD simulation output: probability density plots of epidemic size for the recorded movements (top), the 'ideal' scenario (13 day standstill, no exemptions; middle), 'England / Wales – scenario' (6 day standstill, no exemptions; bottom).
Figure 3. A. Number of infections per 10km^2 for FMD simulation on the originally recorded cattle and sheep movements. **B.** Differences between the FMD simulations on recorded movements and the rewired 'ideal' scenario (13 days Rw- Ex-, top right) and the rewired 'England / Wales – scenario' (Rw+ Ex-, bottom right).

References:
Mohr, S., Deason, M., Churakov, M., Doherty, T. and Kao, R. R. (2018) Manipulation of contact network structure and the impact on foot-and-mouth disease transmission. *Preventive Veterinary Medicine*, 157, pp. 8-18.(doi:10.1016/j.prevetmed.2018.05.006)