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Investigating the effectiveness of regionalized movement bans for the control of foot and mouth disease in the UK

Foot and mouth disease (FMD) is a highly infectious disease that primarily affects cloven-hoofed animals (such as cattle, sheep and pigs) and typically causes fever and blisters in the mouth and on the feet resulting in lameness. Whilst death of livestock is rare, outbreaks of FMD in previously disease-free regions can have huge economic repercussions and devastation to the farming industry, owing to the introduction of movement restrictions, export bans and culling of livestock.

In the United Kingdom there have been two relatively recent outbreaks of FMD. In 2001 a large nationwide epidemic occurred; over 2000 farms were infected and a further 8000 had their livestock culled in an effort to control the disease. The costs of this epidemic have been estimated around £8 billion pounds. In 2007, a small outbreak occurred in Surrey in the South East of England. This outbreak was rapidly contained with only eight farms being found positive throughout the epidemic.

FMD can be transmitted between farms at a local level by direct contact between susceptible and infected livestock, via aerosol spread and via fomites (i.e. contaminated vehicles or farm equipment). However, live animal movements can result in the disease being disseminated over a large geographical area. In the UK, cattle require an ear tag with a unique number; this is to ensure that all animals have a unique identity and that births, deaths and movements on and off farms can be registered for each animal. Records are registered through the Cattle Tracing System, which is run by the British Cattle Movement Service (part of the Department for Environment, Food and Rural Affairs, DEFRA).

Current UK policy in the event of a future FMD outbreak is to introduce a nationwide movement ban as soon as possible after the first reported case. However, a policy in which movement control is introduced at a regional level may minimize the economic impact of the disease, reduce the inconvenience to farmers and still prevent a large epidemic.

We present a metapopulation model that includes local and movement-based spread to test alternate movement ban policies and their effectiveness in reducing spread of disease. We investigate the effectiveness of banning movements (a) based upon proximity to previously reported outbreaks, (b) in regions of high livestock density and (c) in regions with high movement activity. These strategies are tested against the nationwide movement ban policy introduced in 2001 to investigate whether livestock movements could be permitted within certain regions during future outbreaks. The results of this study could be used to modify nationwide movement ban policies and reduce the economic impact of future outbreaks of disease in the livestock industry.