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Research

EDITORIAL

Biosecurity and FMD transmission

A paper summarised in this week's Veterinary Record underlines the importance of biosecurity and of field data in understanding how FMD virus is transmitted between farms during outbreaks, as Aldo Dekker explains

EUROPE is free of foot-and-mouth disease (FMD) without animals being vaccinated. However, since 1992, when the EU implemented a policy preventing prophylactic vaccination against FMD, seven minor or major FMD outbreaks have been documented within the EU. In recent years, other FMD-free countries, such as Korea and Japan, have also experienced outbreaks. This shows that countries officially free of FMD are still at risk. For this reason all FMD-free countries have contingency plans that focus on early detection of infected herds and the prevention of further spread.

Experimentally, the within-pen reproduction number for FMD virus is high in pigs and cattle and relatively low in sheep (Eblé and others 2006b, 2008, Orsel and others 2005, 2007a, b). The reproduction number represents the average number of new infections caused by an average infectious individual. It has also been shown experimentally that separation between pens can limit transmission in pigs (Eblé and others 2006a, van Roermund and others 2010). This supports the notion that transmission between farms depends on the contact structure between farms. Experimental data cannot be extrapolated directly to a field situation. Therefore, field data are needed to optimise control measures as laid down in contingency plans.

Analysis of previous outbreaks has shown that there is a clear relationship between distance between farms and probability of infection (Keeling and others 2001, Boender and others 2010). It should be noted, however, that the underlying mechanisms for this relationship are not clear. Spatial analysis shows that transmission can occur over a considerable distance. Fig 1a shows the relationship between distance to an infected herd and the probability of infection, illustrating that the farms near to an infected herd have the highest probability of infection. Fig 1b shows the number of farms in relation

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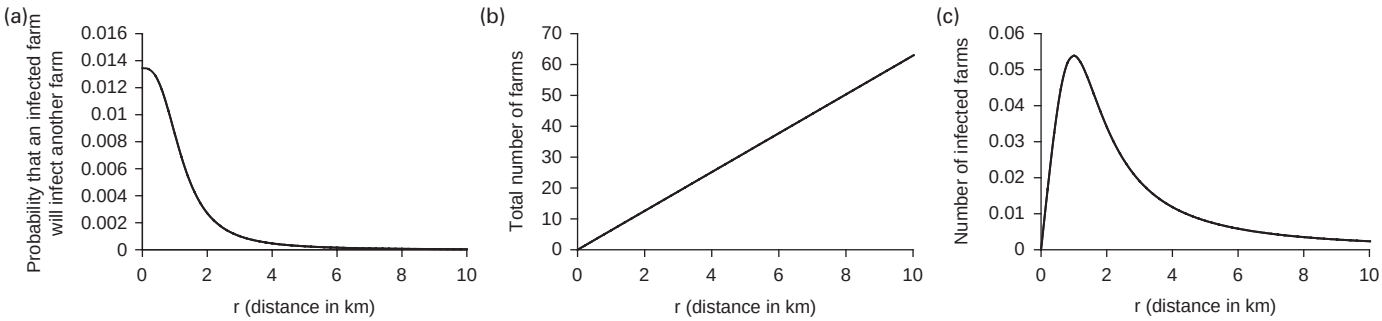

FIG 1: (a) Relationship between the probability of transmission and distance based on pooled data from 23 outbreaks in one area of the Netherlands in 2001 (Boender and others 2010). (b) The number of herds in relation to distance based on a uniform distribution of farms with a density of one farm per km^2. (c) The consequential average number of infections caused by an infectious farm in relation to distance, which is the product of Figs 1a and 1b

to distance and, in this example, is based on a uniform distribution of one farm per km^2. Fig 1c is the result of the product of Figs 1a and 1b and shows the average number of new infections caused by one infectious farm in relation to distance. This graph shows that infection can travel a considerable distance.

If movement of animals has been stopped, it is unlikely that transmission has been caused by direct contact between animals on the farms. Although airborne transmission cannot be excluded, when airborne transmission models are run with average numbers for virus excretion and susceptibility, rather than the maximum ever found, the probability of airborne transmission is very low. So the most likely transmission route is through the gate and not over the fence. Therefore, the observed transmissions over more than 1 km are most likely caused by people.

There is also a possibility of increased indirect transmission by humans after implementation of control measures. In the 2001 outbreak in the UK, the estimate of the between-farm reproduction number was 3.3 (Woolhouse and others 2001) before control measures were implemented, and 1.1 after control measures were implemented. An earlier study found that approximately 77 per cent of the known transmissions routes were animal transport related (Dijkstra 1955). If this number is extrapolated to the FMD outbreak in the UK in 2001, the ban on animal transport would have resulted in a between farm reproduction number of 0.8 (23 per cent of transmission not caused by animal movements of 3.3 farms). Although these numbers should be interpreted with care, they possibly suggest the development of new transmission routes after the implementation of control measures. Although illegal movement of animals cannot be excluded, the increase could be caused by an increased number of people moving between farms.

These two examples show that, although parts of the transmission process can be quantified, it is still essential to identify specific risk factors. An interesting addition to the current knowledge can be found in the paper summarised on p 128 of this week's *Veterinary Record* by Ellis-Iversen and others (2011). Dr Ellis-Iversen and others present a case-control study on risk factors for FMD virus transmission carried out during the 2007 UK outbreak. The only significant risk factor identified in this study was a biosecurity risk score. This biosecurity risk score was composed of various factors such as the presence/use of gates/barriers to livestock areas, signs prohibiting entry, boot dips and farm-specific clothing. This study shows the importance of biosecurity and sets an admirable example, which will hopefully be copied by others.

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