Isobel McLachlan[1,2] , Glenn Marion[2] , Iain McKendrick[2], Ian Handel[1], Thibaud Porphyre[1] & Mark Bronsvoort[1]

Isobel.McLachlan@bioss.ac.uk

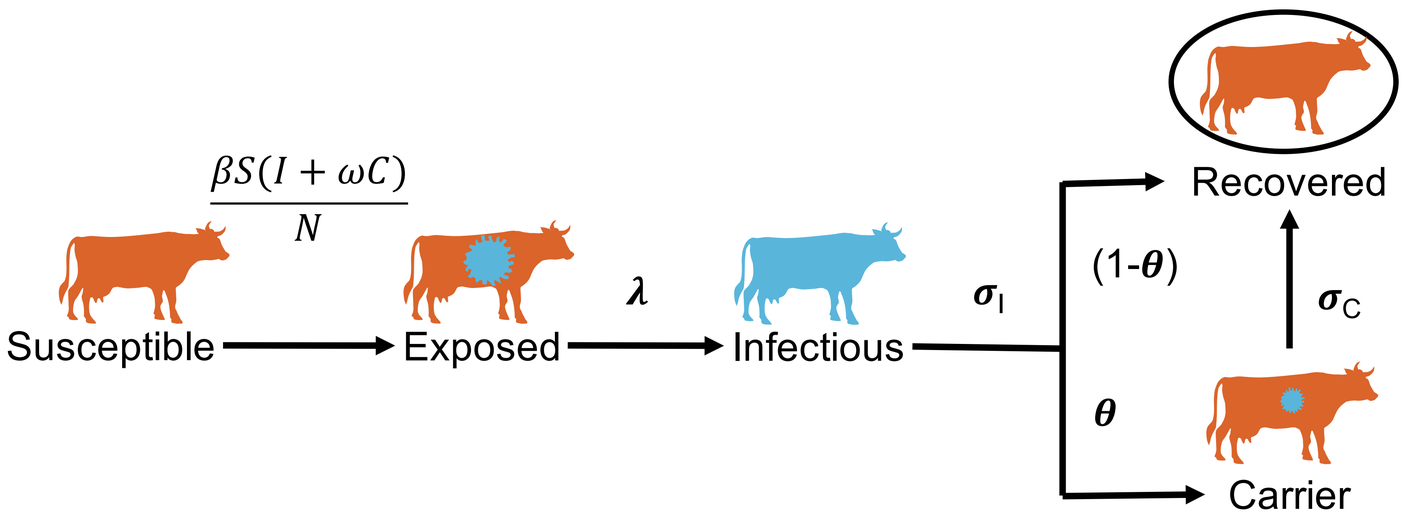
[1]*The Roslin Institute. Easter Bush Campus, Midlothian, UK*

[2]*Biomathematics and Statistics Scotland, Edinburgh, UK*

Modelling the role of carriers in endemic foot and mouth disease

Introduction - FMD in tropical and sub-tropical regions

- FMD virus persistently circulates in many such regions
- Differences in epidemiology compared to FMD-free/epidemic regions
- Transmission from persistently infected 'carriers' controversial
- Evidence sparse/anecdotal; limited objective field or experimental data
- Models enable structured approach to reasoning about impact of different mechanisms on disease dynamics
- **Aim - Understand impact of 'carriers' on persistence**



Compartmental within-herd model

- Death rate (μ) applied to all epidemiological states
- Stochastic model
- R_0 = 4.5, within estimated range for FMD[1,2]
  - Consistent R_0 for all scenarios
  - $R_0 = \frac{\lambda\beta}{(\lambda+\mu)(\sigma_I+\mu)} \times \left(1 + \frac{\omega\theta\sigma_I}{(\sigma_C+\mu)}\right)$
- Isolated herd of 70 individuals[3]

Key initial results from within-herd model

Figure 1 - Example run of disease dynamics from an isolated herd with carriers

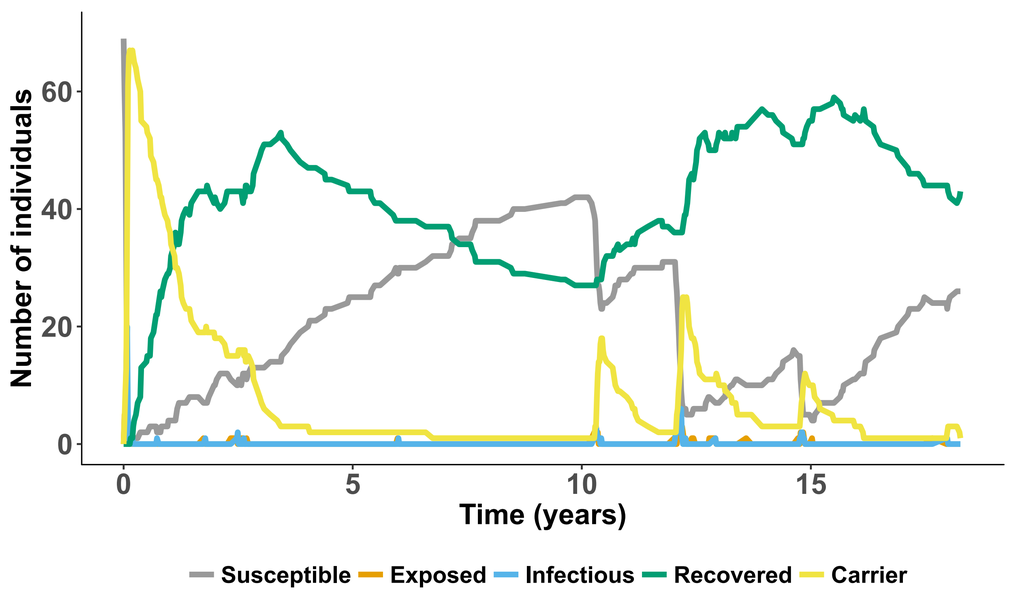
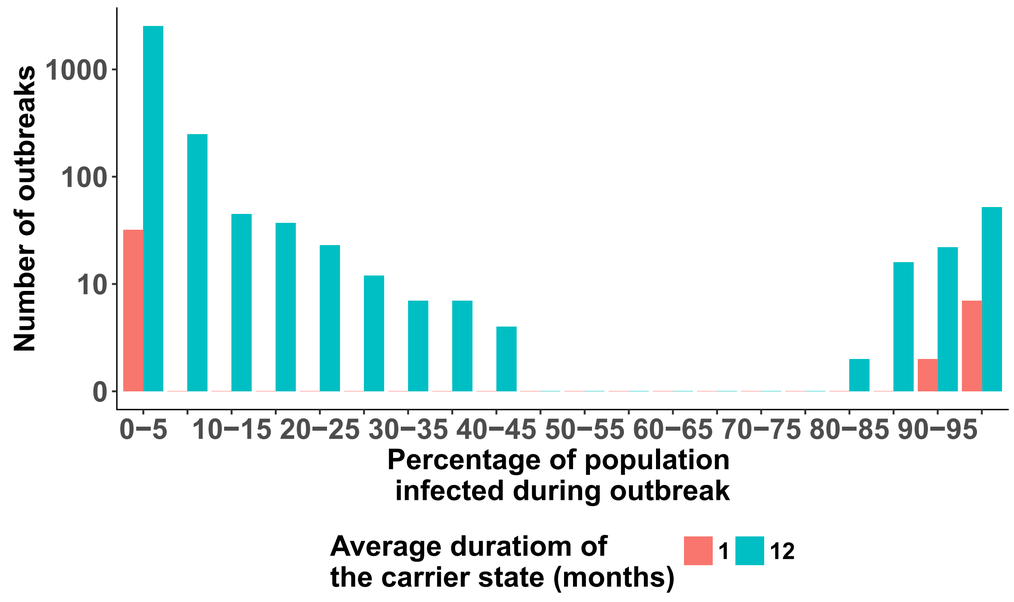


Figure 2 - Impact of difference transmission dynamics on outbreak size and number of outbreaks



- Addition of carrier state enables FMD virus to persist beyond initial outbreak in an isolated herd (Figure 1)
  - Average persistence increases with increased duration of the carrier state
- For fixed R_0 investigated impact of different average durations of carrier state on transmission dynamics (Figure 2) showing that
  - Longer carrier state leads to more outbreaks
  - Predominantly small outbreaks

Conclusions

- In an isolated herd, carriers required for viral persistence beyond initial outbreak
- Details of carrier state can alter disease dynamics
- Better understanding of role of carriers in observed disease dynamics required

[1]Pomeroy *et al.*, 2015 doi: 10.1371/journal.pone.0136642
[2]Lazarus et al., 2017 doi: 10.1016/J.PREVETMED.2017.08.016
[3]Egbe *et al.*, 2017 doi: 10.1038/s41598-017-04230-6