

Network analysis of livestock movements in New Zealand pastoral farms in regard with disease transmission

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Social network analysis (SNA) provides valuable information to predict herd-level disease status. Livestock movement data for 2006 to 2010 were provided from Landcorp Ltd. (LC), a state-owned enterprise comprised of 127 farms throughout New Zealand (NZ). In total there were 3,531 movement events involving 1.15 million sheep, cattle and deer. In this paper we describe our analytical approach and its relevance to the transmission of infectious disease. Contacts were defined at the level of batches or valued with the number of animals (relevant for chronic disease transmission). Most movement events (97%) were within the same island (97%) rather than between the North and South islands. The network showed a high level of clustering of farms. There was a high variance in the number of individual contacts per farm and a positive correlation between the number of contacts in and out of farms. This could favour disease transmission through highly connected farms. Depending on the year, 82 to 95% of farms were directly or indirectly connected by animal movements, facilitating transmission of disease. Removing the 10% of farms linking the clusters contributed significantly to disconnecting the network, which fell apart into smaller, less interconnected clusters. Analysing the consistency of movements between years showed that the number and intensity of contacts were consistent across years. However, 80% of farms shifted their trading partners between years. Time (in)consistency of the pairs of farms is an appropriate measure to analyse farm-to-farm transmission of chronic diseases such as paratuberculosis. SNA identified central farms in the observed contact pattern. We show the potential impact of targeting these farms to efficiently decrease the connectedness of the network. The understanding of the pattern, intensity and consistency of contacts is a first step for evaluating associations between movements of livestock and infectious disease.