AN INVESTIGATION OF FARM CONTACTS AND THEIR POTENTIAL IMPACT ON DISEASE TRANSMISSION IN SMALLHOLDER CATTLE PRODUCTION IN BUNGOMA COUNTY OF WESTERN KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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ABSTRACT

Farm animal movement usually occurs during grazing, watering, and dipping and livestock trade among others. These movements create contacts between different farms and the contacts created form networks of varying magnitude ranging from local to international depending on the scale of movement of animals. The networks are dynamic in nature and are mostly influenced by season which determines the availability of pasture and water. Contacts created act as routes through which disease pathogens may spread between farms in various geographical locations. Farms which are infected act as sources of infection to other farms when there is movement of animals from the infected farms to non-infected farms.

Limited studies have been done in Africa on contact networks between herds to give a better understanding of the spread of infectious pathogens. Most predictive models for farm animal diseases focus on gathering information and estimating transmission parameters with little attention on modeling the underlying network of contacts. These models also ignore the complex structures present at different levels including between animals, farms and the regions. Lack of accurate information on contact structures and the factors affecting them is also a challenge when complex structures are considered. Therefore understanding of the contact networks between farms is critical in instituting proper surveillance and control measures. The overall objective of the study was to determine and assess the types of contact networks between herds and the potential for transmission of diseases. The specific objectives were to determine the existing contact networks between cattle herds, to determine the frequency of the contact network between farms and to determine the factors affecting heterogeneity in contact in the study area.

The study area was in Kimilili Sub-county of Bungoma County. This was a cross sectional study involving seven villages randomly sampled. A census of all cattle keeping households in the sampled villages was undertaken. Farm contacts within these villages of Bungoma County were
explored using contact structure interview which involved a combination of photo-elicitation, structured questionnaire and a contact collection form.

In total 329 farms were included in the study. The farm contacts as a result of sharing grazing fields, water points for the four weeks during the wet season (October-December) together with breeding and ploughing contacts for the last one year of the study was reconstructed and analyzed for the seven villages. The overall farm networks for the various farm contacts in the villages were also visualized.

There was significant difference in the proportion of farmers that took their animals for grazing outside their farms daily during dry and rainy season ($z = 6.52$, $p=0.0000$,) and the proportion of farms that took their livestock for water daily outside their homestead during dry and rainy seasons was also significantly different ($z = 2.75$, $p=0.006$). The overall farm contacts and the distances among the farms were negatively correlated in all the villages. Contact of cattle at common water points was significantly influenced by extensive grazing management practice in the farm ($p=0.0000$, OR=9.57), number of animals kept in the farm ($p=0.0212$, OR=1.23) and presence of cross breeds in the farm ($p=0.0044$, OR=0.37). The networks in the villages resembled undirected scale free graphs with a normalized degrees; 9.6 (Namunyiri), 10.6 (Malaha), 11.5 (Sango), 11.8 (Kibunde), 12.9 (Lutonyi), 13.1 (Lurare) and 14.0 (Chebukwabi). The topology of the networks was heterogeneous with some farms exhibiting high degree of contacts compared to others.

It is observed that an introduction of some disease pathogen in the villages would lead to increased rate of spread of the disease in Chebukwabi, Lutonyi and Kibunde due to higher values of coefficient of variation which basic reproduction number (Ro) incorporates due to heterogeneous in networks. Therefore Ro will be higher in the three villages compared to the other villages. There was high rate of bull sharing in the farms both within and outside the villages and this posed a major risk to the spread of sexually transmitted infections. Extensive
grazing management and the keeping of higher number of cattle in the farms were more likely to increase farm contacts in the villages. It is recommended that studies should be conducted to describe farm contacts during dry season and also contacts between the villages so as to give a better understanding of the structure of the networks which will help in the design of effective surveillance and control strategies by the veterinary department.