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An effective sero-surveillance program for detection of low pathogenic avian influenza outbreaks in layer chickens

Gonzales, J.L.[1], Boender, G.J.[1], Stegeman, J.A.[2], Elbers, A.R.W.[1] and De Koeijer, A.A.[1], [1]Central Veterinary Institute part of WUR, Netherlands, [2]Faculty of Veterinary Medicine, Utrecht University, Netherlands; pepevet2@hotmail.com

Low pathogenic avian influenza virus (LPAIv) of the H5 and H7 subtypes can mutate to a highly pathogenic virus when infecting poultry. Hence early detection of LPAIv outbreaks will reduce the probability of pathogenicity mutations and large epidemics. The objective of this study was to develop a model for the design and evaluation of an effective and efficient serological surveillance programme for LPAIv infections in layer chicken flocks. We aimed at early detection and culling of an infected flock before it infects more than one other flock (between flock reproduction ratio R_f<1), hence a large epidemic cannot occur. We used a mathematical model that explores the effect of sample size and sampling frequency on timely detection. The model takes into account the LPAIv within- and between-flock infection dynamics as well as the diagnostic performance of the test used for surveillance. Since layer flocks are the target population, we explored the value of using eggs as an alternative to sera as sample commodity. The model was subsequently applied to refine the Dutch serological-surveillance programme. Using a transmission kernel, the R_f for each flock was estimated and a transmission-risk map was constructed. The latter was used to target a risk-based surveillance strategy. Most flocks (79%) had an R_f<1 and an early detection programme in areas where these flocks are located would not be required. Early detection could be implemented in areas with flocks with an expected R_f>1. For example, in areas/flocks where R_f=2.2, sampling ten sera samples/flock every month would ensure early detection. If eggs are sampled, 90 samples every month would be required. In conclusion, we present a model that can be used to explore different sampling strategies and can aid implementation of effective surveillance programmes for low pathogenic avian influenza.