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Simulation based models may assist the identification of potentially large outbreaks

Lyytikäinen, T.[1], Sahlström, L.[1], Virtanen, T.[1], Niemi, J.[2] and Lehtonen, H.[2], [1]Finnish Food Safety Authority, Risk Assessment Research unit, Finland, [2]MTT Agrifood Research Finland, Finland;
tapani.lyytikainen@evira.fi

During an outbreak of a highly contagious animal disease, the ability to pin down potential large outbreaks would be valuable for proactive risk management. A simulation model was applied to produce 100,000 different outbreak scenarios for Foot and Mouth disease (FMD). Scenarios were started from every Finnish pig and cattle farm. If the simulated outbreak included more than 17 farms, it was considered a large outbreak. A predictive model for large outbreaks was then developed (GLM, binomial-family, logit-link). The probability of the large outbreaks was predicted in the model by the location, number of contacts within 30 days, production type and size of the primary infected farm (PIF). The most valuable information for the prediction was the number of contacts of the PIF (Wald χ^2=3,000.6; P<0.001). Production type of PIF had the second largest effect on prediction (Wald χ^2=1,073.1; P<0.001). Size of the PIF did not have a significant effect on the probability (Wald χ^2=0.9; P<0.357). Large outbreaks were most probable if the outbreak started from a dairy or sow farm. Location of the PIF in high risk regions increased the probability of a large outbreak (Wald χ^2=787.7; P<0.001). Some additional predictive value was achieved also by knowing whether the PIF was located in either of two CVO-districts having the highest farm density (Wald χ^2=40.2; P<0.001). By applying a cut-off point of 0.08, the model sensitivity was 55.8% and specificity 15.6%. Properties of the PIF could be applied as one indicator of a large outbreak, although this may have a quite limited value. However, by applying the function we were able to pin down over 55% of large outbreaks, which was ten times more than the expected value for large outbreaks in the country (5.4%). Predictive modeling would be most beneficial when applied in contingency planning before any real outbreaks are on hand.