Sensitivity of surveillance programs in vaccinated poultry populations

When implementing surveillance programs based on active surveys for detecting the introduction and circulation of HPAI virus in vaccinated poultry populations, several key questions must be addressed to define the program's sensitivity and, consequently, its efficacy. These questions include the type of sample, the number of samples to be taken, the type of diagnostic test to be used, and the timing and frequency of sampling. How we address these questions depends on the targeted output (the objective) of our surveillance strategy. In this presentation, we explore methods for identifying (cost-) effective sample sizes, sampling frequencies, and sample-test combinations to design efficient surveillance programs. We examine surveillance design under two vaccination scenarios: 1. Emergency vaccination, and 2. Preventive vaccination.

1. Emergency vaccination is applied to help control epidemics once an outbreak, or multiple outbreaks, have been detected in a naïve population. In this scenario, emergency surveillance is used as an additional control tool aimed at early detection and removal of vaccinated-infected farms before they transmit infection to one or more other farms. Transmission is measured in terms of the between-farm reproduction number, R. We present a surveillance design approach where efficacy is assessed by the program's ability to reduce R below 1. To achieve this, we present an approach that shows how different combinations of sample size, sampling frequency, sample type, and diagnostics can lead to early detection ($R < 1$) with a high level of confidence.

2. Preventive vaccination is applied before any outbreaks are observed, with the objective of protecting poultry and minimizing the risk of infection introduction. In this scenario, surveillance may be used as a tool to maintain and prove freedom from infection. Given the uncertainty around whether and when the virus may enter a poultry flock, we propose that the sample size and sampling frequency of the surveillance program be determined by the desired confidence level in maintaining freedom from infection (e.g., >95%). To this end, we demonstrate an approach based on scenario tree modeling and temporal discounting to design an effective surveillance program.

Examples of both scenarios and their respective surveillance design approaches are presented, highlighting different effective strategies with comparable efficacy. Decision-makers can then select the strategy that best fits their country's specific conditions.