Module 18

Modeling Avian Influenza Immunity Distribution Profile Through the Poultry Production Network in Egypt: A Decision Tool for Zoonotic Influenza Management


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ABSTRACT

Vaccination against avian influenza (AI) is currently applied worldwide with inactivated vaccines. Since November 2012, a novel recombinant H1N1-AH5 (Herpesvirus of turkeys as vector) vaccine has been commercialized and applied to day-old chicks (DOC) in some industrial hatcheries in Egypt (Kilany, 2014; Kilany, 2012). The objectives of this study were to assess the cost-effectiveness of AI DOC vaccination in hatcheries and the feasibility of implementing AI DOC vaccination in the different production sectors in Egypt.

A model of the Egyptian poultry production network was combined with a model on flock immunity to simulate the distribution profile of AI immunity according to different vaccination scenarios (including DOC vaccination or not). The model estimated the levels of vaccine coverage for each node of the network and vaccination scenario and positive sero-conversion levels and the duration of sero-protection.

The model predicted that targeting DOC AI vaccination in industrial and large size hatcheries would increase immunity levels in the overall poultry population in Egypt and especially in small commercial poultry farms (from >30% to >60%). This strategy was shown to be more efficient than the current strategy using inactivated vaccines. Improving HPAI control in the commercial poultry sector in Egypt would have a positive impact effect to improve disease control.

This innovative approach to the outcome of AI immunity predictive model supports the design of a more efficient HPAI disease control plan in Egypt. This model may be replicated in other AIV endemic countries that wish to better manage infections or emerging disease threats.

STUDY OBJECTIVES

We combined network analysis of poultry production systems with an immunity model to study the distribution profile of avian influenza immunity in flocks through the commercial poultry production network in Egypt.

The specific objectives were:
1. To model the movement of DOC within the poultry value chain in Egypt
2. To estimate vaccine coverage and sero-conversion levels according to different vaccination scenarios including DOC vaccination.

RESULTS

The model demonstrated a statistically significant increase of vaccination coverage (>40%; p<0.05) within the total population if hatchery vaccination was implemented in integrated and large farms (Fig. 2A). By only vaccinating integrated DOC (Sc. 2), vaccine coverage in large and medium sized farms would reach 80%.

The model predicted that targeting DOC AI vaccination in industrial and large size hatcheries (Sc. 4) would increase immunity levels in the overall poultry population in Egypt and especially in small commercial poultry farms (from >30% to >60%) (Fig. 2B) (Bouma, 2009).

Spatial analysis of AI immunity distribution demonstrated that under Sc.4 the immunity level density (both in terms of coverage and sero-protection) would increase above the threshold levels in the most at risk Governorates (Fig. 3).

DOC vaccination would be cost-effective either as prime-booster strategy with one boost of inactivated vaccine or as single dose vaccination both for long cycle and broiler birds whatever the current inactivated vaccination protocol in place (Table 2).

CONCLUSIONS AND PERSPECTIVES

This study demonstrated the interest of combining network analysis and immunity modelling to assess the efficacy of AI vaccination scenarios in Egypt.

The model predicted that targeting DOC AI vaccination in integrated and large hatcheries would increase immunity levels in the overall poultry population in Egypt, and especially in small commercial poultry farms, up to sufficient levels to improve HPAI disease control in Egypt.

This strategy was shown to be more efficient than the current strategy using inactivated vaccines. This approach would have only marginal impact on immunity levels in Sector 4 household poultry. However, improving HPAI control in commercial poultry sector in Egypt could have positive spillover effect on the epidemiological situation of the disease in the household sector (Sector 4).

Effectiveness assessment of this strategy and therefore field validation of the model outputs could be done by assessing the impact of DOC AI vaccination in pilot areas in Egypt, where it is already being implemented in Sector 1 and 2 hatcheries. Moreover, the impact of commercial DOC AI vaccination on the epidemiological situation of the disease in Sector 4 could be assessed by increasing disease prevalence surveillance in LBNs in the areas where the AI vaccinated DOC would be applied.

REFERENCES


