

## Modeling immunity distribution profiles through animal value chain network: a decision tool for disease management

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**Purpose:** Vaccination against avian influenza (AI) is currently applied worldwide with inactivated vaccines. Since November 2012, a novel recombinant HVT-AIH5 (Herpes virus of turkeys vector) vaccine has been commercialized and applied to day-old chicks (DOC) in Egypt and in Bangladesh. 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 HPAI H5N1 endemic countries.

**Methods:** For each country, a model of the poultry production network was combined with a model of flock immunity to simulate the distribution profile of AI immunity according to different vaccination scenarios (including DOC vaccination or not). The model estimates the vaccine coverage rate, positive sero-conversion levels and the duration of sero-protection for each network node. Economic evaluation of the different strategies was performed using cost-effectiveness analysis. spatial analysis was performed to account for spatial clustering of the different poultry production types.

**Results:** In all study areas the model predicted that targeting DOC AI vaccination in industrial and large size hatcheries would increase immunity levels in the overall poultry population and especially in small commercial poultry farms. The level of improvement and best scenario was variable according to the specificity of each production networks. DOC vaccination strategy was shown to be more efficient than the current strategy using inactivated vaccines.

**Conclusion:** This study demonstrated the interest of combining network analysis and immunity modelling to assess the efficacy of AI vaccination scenarios. The model predicted that targeting DOC AI vaccination would increase immunity levels in the overall poultry population up to sufficient levels to improve HPAI disease control.

**Relevance:** Improving HPAI control in commercial poultry sector could have positive spill over effect on the epidemiological situation of the disease in backyard poultry. This model could be applied for strategic management of other contagious diseases such as Newcastle Diseases.