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SCHOOL OF COMPUTER SCIENCE

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A Decision Support Framework to Predict the Risk of Avian Influenza Outbreaks

Samira Yousefi

Chair: Dr. Joseph Sawada
Advisor: Dr. Rozita Dara
Advisory Committee: Dr. Zvonimir Poljak [Population Medicine]
Non-Advisory Committee: Dr. Luiza Antonie
Non-Advisory Committee: Dr. Theresa Bernardo [Population Medicine]

ABSTRACT:
Forecast systems are of vital importance when preparing for epidemic outbreaks. In the last several decades, avian influenza (AI) virus has caused numerous outbreaks around the world. These outbreaks pose a serious threat to the poultry industry and also to public health in many parts of the world. In order to respond to these threats, accurate knowledge to make appropriate decisions is required. Also, decisions in emergencies need to be made within a short time frame to reduce the risk of introduction and the spread of AI virus. A large number of studies have involved analytical models to gain better understanding of how AI outbreaks occur and also to facilitate determining which factors contribute to AI progress. AI has been studied from different perspectives and scales, and each has shed light on a specific angle of the problem. However, the existing information management systems usually utilize imperfect information to support veterinary epidemiologists in predicting the risk of AI outbreaks. Moreover, the majority of the developed systems are unable to provide a timely understanding of outbreak situations. Accordingly, containment decisions are performed late and in the form of mass actions (e.g. instead of targeted depopulation or immunization), which lead to poor consequences. Therefore, addressing the timeliness and comprehensiveness of risk prediction and assessment of AI would be of great value for making quality decisions.

The present study aims to propose a framework for prediction and control of AI outbreaks and comprises several modules, including (1) online surveillance to warn and forecast the risk of outbreaks; (2) network-based simulation-optimization to mimic the spread of disease and explore a wide range of control measures at farm-level; (3) utilizing several data sources to forecast highly pathogenic avian influenza (HPAI) outbreaks globally; and (4) fuzzy rule generation and reasoning in order to suggest optimum actions automatically based on the level of risk. The present work provides clearer insights into the space-time occurrence and spread of AI. We performed a preliminary experiment of the first component, online surveillance. We visually and statistically show that Twitter can be used as a surrogate for official reports of AI outbreaks. We also found that the majority of AI outbreak notifications are detectable from Twitter. The findings of this study can enable emergency preparedness to determine prioritized interventions and consequently halt or limit the further spread of AI across the world.