EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

Market Size and Avian Influenza Strain Spillover Risk

CHALLENGE

Resources to conduct biosurveillance are limited. Examining past research and computational models helps determine where it is best to conduct surveillance for diverse strains of avian influenza virus that might spillover to people. The risk of spillover, and the drivers of viral evolution likely change significantly along the animal value chain. It would be useful to identify which of the following sampling locations has the highest likelihood of generating a successful spillover so that it can be preferentially targeted:

- large market hubs
- small markets
- in the field (e.g., where poultry interacts with wild birds)
- a combination of the above locations

APPROACH

A typical live bird market with 500 animals was modeled. The species diversity from just 3 species (below average) to over 40 was varied and compared against the introduction of a novel virus of a single genotype, in one specific host in the 'virtual' market. The model assumes that the virus does not yet have a great enough transmission rate or virulence to create an epidemic, but a transmission rate that is close to the epidemic threshold (i.e., R_0 is just less than 1). Each time this virus infects a new host, a new genotype is generated, based on random change from the infecting genotype. Lastly, Neutral Theory is used to specify the species distribution in the market, for a given total number of species and total abundance of animals.

RESULTS

The figure below illustrates how the risk of zoonotic spillover (transmission of avian influenza from animals to people) and epidemic failure (inability of the novel virus to spread among animals within the markets) changes as we move from a market with low species diversity to one with high diversity.

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For details on methods or analysis contact:
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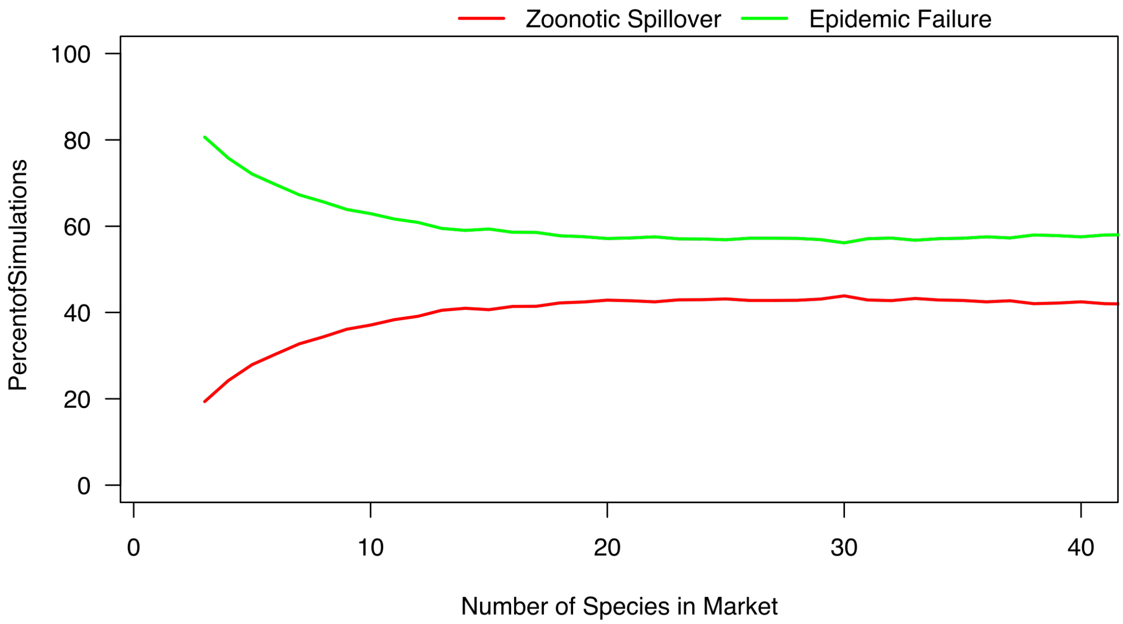

CONCLUSIONS

As diversity increases from 3 to 20 species in a wet market, the risk of zoonotic spillover doubles (from 20% to 40%), and the efficiency of transmission among the animals within the market increases similarly. Based on the results of the model, and consistent with market studies, surveillance for avian influenza diversity and potential for generation of novel strains change should be conducted in areas where the diversity of animal species is higher, e.g.: sites where wild birds and poultry comingle, in markets near wetlands, and in markets with high species diversity, regardless of market size. In contrast, targeting surveillance to large markets that have three or less species (e.g. those with only ducks and chickens) is less likely to identify likely origins of future pandemics. Finally, it's important to note that this is a preliminary study and will be improved significantly with the surveillance of a diversity of markets during EPT2.