Exploring Spatial-Temporal Clustering, Aggregation, and Transmission of Avian Influenza Virus in Taiwan

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Abstract

Background: Avian flu outbreak in poultry farms exhibited spatial clustering, which was conveniently explored by plotting the incident outbreaks and theoretically tested by *spatial scan statistics*.

Objectives: To explore the *second-order spatial clustering* according to various levels of resolutions, and estimate the transmission direction through a conventional *Standard deviational Elliptic* (SDE) method.

Methods: Likelihood-ratio statistics were constructed at different levels of spatial resolution with 'element areas' being a fine partition of townships decided by the smallest administrative units. Different 'null' spaces used as reference populations were compared to form an aggregation map (called *AGC map*) depicted to reveal the secondary aggregation of geo-clustering of outbreaks. A *Knox statistic* was used to decide, *a priori*, suitable partitions which formed independent clusters for subsequent explorations for spatial transmission.

Results: The AGC map offers second-order aggregation of disease spatial clustering, which also implies transmission directions. Knox statistic is useful for making partitions on time axis and on spatial expansion. Transmission direction can be explored by simply connecting the centers decided by the SDE method, contrasted with the *time-dependent* AGC map.

Keyword: Avian flu outbreak, spatial scan statistic, aggregation, transmission, Knox statistic