

Genetic Variation of Highly Pathogenic H5N1 Avian Influenza Viruses in Vietnam Shows Both Species-Specific and Spatiotemporal Associations

Margaret Carrel, Xiu-Feng Wan, Tung Nguyen, and Michael Emch
Contact Address: margaret-carrel@uiowa.edu

Important Findings

Domestic poultry act as a reservoir for persistent H5N1 endemicity in Vietnam, and the circulation of poultry flocks across farms and to market is thought to drive the spatial movement and evolution of avian influenza viruses. This study explored potential differences in genetic characteristics according to species of isolation and the spatiotemporal characteristics of the viruses (Figure 1). The findings suggest that genetic evolution of avian influenza viruses is continuous through time but could also be mediated by the species in which the viruses occur, information that has implications for prevention efforts.

Significance of Findings

Previous research in Thailand implicated free-ranging duck populations as a driver of H5N1 incidence and suggested that new restrictions on the housing and grazing of ducks would decrease H5N1 outbreaks in that country. In Vietnam, the sharing of duck grazing areas among multiple farms was positively associated with H5N1 outbreaks. Perhaps free-ranging backyard duck populations in Vietnam are driving not only H5N1 incidence in Vietnam but also viral evolution. Chickens are typically confined to the backyards of households whereas ducks are generally free-ranged and travel outside of the household to fish ponds and rice fields. Thus, duck epidemiologic response to influenza infection, coupled with their ecologic patterns, could allow for greater viral mixing, including those viruses from wild birds, and for emergence of novel genotypes. This study suggests that attempts to control influenza in duck populations, particularly via regulation of backyard duck husbandry practices, could also curtail the evolution of H5N1 viruses.

Additional Information

Highly pathogenic H5N1 avian influenza was first detected in Vietnam in 2001, and the country was part of a larger endemic emergence of H5N1 across Southeast Asia in 2003 and 2004. Since 2003, Vietnam has remained one of the countries hardest hit by H5N1 avian influenza, with continuing poultry and human infection and mortality. H5N1 viruses have undergone rapid evolution in Vietnam since first detection, and since 2003 at least four novel types have emerged in Vietnamese H5N1 isolates. Part of the reason for the persistence of H5N1 in Vietnam is socio-environmental: among Vietnamese there is a preference for live or freshly killed poultry, and a large percentage of rural Vietnamese rear their own backyard poultry flocks. Large numbers of susceptible birds, combined with the circulation of birds and people from farms to markets, drive the ongoing H5N1 epidemic.

Backyard poultry flocks in Vietnam are composed primarily of chickens and aquatic poultry such as ducks. According to a 2003 livestock census, of Vietnam's 261 million domestic poultry, 73.5% were chickens and 26.3% were aquatic birds. Both chickens and ducks in Vietnam are raised by poor rural families as scavenger birds, feeding on insects and other pests, but chickens are confined to the

household area whereas ducks are often taken out of the household into nearby fish ponds and rice fields. Duck populations thus have opportunities for interaction with other domestic duck flocks and with wild or migratory birds in aquatic environments that act as a medium for exchange of viruses. Although H5N1 viruses in dried feces quickly lose their infectivity, sometimes in as little as a day, laboratory tests indicate that H5N1 avian influenza viruses can survive in water sources for extended periods of time. Ducks infected with H5N1 have been shown to shed viruses not only fecally but also orally, via the trachea. Infection can thus be transmitted via feces and saliva through shared water supplies, and ducks have great potential to encounter contaminated water and other environmental surfaces outside the household, whereas chickens are confined to exposure within the household. Transmission of H5N1 within such domestic poultry could provide the major mechanism by which avian influenza viruses remain endemic in Vietnam.

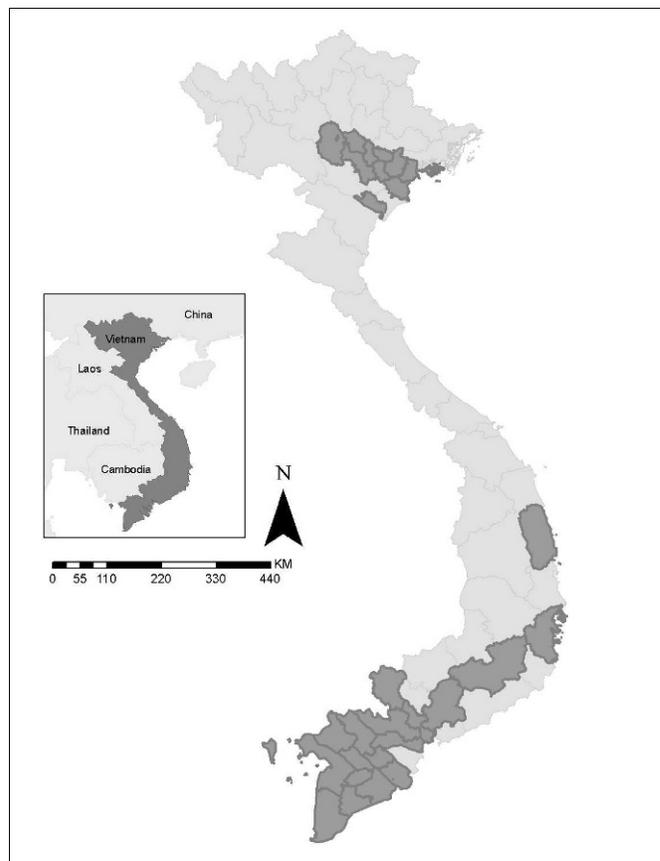


Fig. 1. Distribution of 110 chicken and duck H5N1 viruses in Vietnam. Darkened provinces indicate locations of virus isolation.

Fig. 1. Distribución de 110 virus H5N1 de pollos y patos en Vietnam. Las provincias en tono más oscuro indican los sitios donde se hizo el aislamiento de los virus.