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Studies on the control of avian influenza virus infections in
poultry and humans

（家禽とヒトにおける鳥インフルエンザウイルス感染の制御に
関する研究）

Live bird markets (LBMs) are known to be reservoirs and transmission hubs for avian influenza viruses (AIVs) to the environment in developing countries including Vietnam. In Asia, highly pathogenic avian influenza viruses (HPAIVs) are known to circulate in LBMs, and it has been hypothesized that LBMs may facilitate the emergence and spread of new viral reassortants due to close contact amongst the infected birds. Furthermore, it has also been shown that, in China, human infections of AIVs, in particular, of the subtypes H5N1, H5N6, and H7N9 are associated with recent exposure to poultry in LBMs. However, LBMs closure in developing countries remains challenging because changing the traditional market style should take a long time. Therefore, government interventions by the improvement of the hygiene status as well as upgrading infrastructure at LBMs have been considered as the best solution to minimize the transmission of viruses in Asian countries such as Vietnam.

In Chapter I, the characteristics of LBMs with improved infrastructure (“intervention LBMs”, $n = 3$) were compared with those operating in a routine manner ($n = 6$) in Thua Thien Hue province in Vietnam. The study showed that various subtypes of AIVs were

isolated during surveillance of LBMs with or without intervention. In addition, H5N6 HPAIVs were isolated from apparently healthy ducks, Muscovy ducks and environmental samples in one of the intervention LBMs. And the prevalence of AIVs in intervention LBMs was similar to that in non-intervention LBMs. These results suggest that the interventions currently applied in LBMs are insufficient to control avian influenza.

To identify the factors contributing to AIVs circulation in both types of LBMs, Chapter II focused on quantification of bird-, poultry seller- and market-level characteristics that rendered individual birds more likely to be AIV isolation positive at the time of sale. The results demonstrate that after adjusting for clustering at the market- and individual seller-level none of the explanatory variables solicited in the questionnaire were significantly associated with AIV positivity. A relatively small component of the variation in AIV positivity risk was at the individual market-level. It indicates that the emphasis of AI control efforts should be at the seller-level rather than market-level.

In Chapter III, to prepare for the emergence of the H7N9 influenza pandemic, an inactivated whole particle H7N9 influenza vaccine was selected from an H7N9 AIV, A/duck/Mongolia/119/2008 (H7N9) in the influenza virus library. The potency test of the selected vaccine against the challenge of a novel virus, A/Anhui/1/2013 (H7N9) isolated from a Chinese woman was evaluated in the mouse model. The results indicated that A/duck/Mongolia/119/2008 (H7N9) vaccine induced enough immunity to prevent the impact of the disease caused by H7N9 influenza virus. And the vaccine prepared from an influenza virus strain stored in the library could be useful as a vaccine strain in case of an influenza pandemic.

These present studies provide a better understanding of AIVs circulation and current avian influenza control strategies for poultry and humans. It is also support to the early preparation of influenza pandemic.