

## Measures to combat H7N9 virus infection in China: Live poultry purchasing habits, poultry handling, and living conditions increase the risk of exposure to contaminated environments

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### Summary

From March 31 to May 31, 2013, 132 cases of humans were infected with the H7N9 avian influenza virus, 39 of which resulted in death in China, which sparked global concerns about public health. Fortunately, no new case was reported in China since May 8, which seems like to make it step into a stable stage, and the emergency response to the event launched by Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Shandong, and Hu'nan of China have been terminated currently. However, on July 20 and August 10, two new cases were reported from two provinces - Hebei and Guangdong - where no case was reported during the period of spring of 2013. The emerged two new cases rung an alarm bell, thus, the continued public health response cannot let down its guard. Based on our before studies, we found that live poultry purchasing habits, poultry handling, and living conditions increase the risk of exposure to H7N9 virus contaminated environments in China. Due to the difficulty in changing live poultry purchasing habits and in thoroughly removing or closing live poultry markets in China, we suggest that enhanced regulation of poultry markets would be a more feasible and effective strategy to fight against H7N9 virus infection in China. Moreover, in view of the fact that frequent and inevitable contact between rural residents and poultry where rural residents lived also exists due to poultry handling and living conditions, the enhanced regulations on environmental health are also needed for free-range poultry, especially in rural areas.

**Keywords:** H7N9 virus, avian influenza, environmental exposure, live poultry market

### 1. Introduction

On July 20, 2013, a 61 years of age female living in Hebei was laboratory-confirmed with H7N9 virus infection and dead on August 11 (1), besides, on August 10, another 51 years of age female infected with H7N9 virus was also laboratory confirmed in Guangdong and now remains in hospital in a critical condition (2). Both

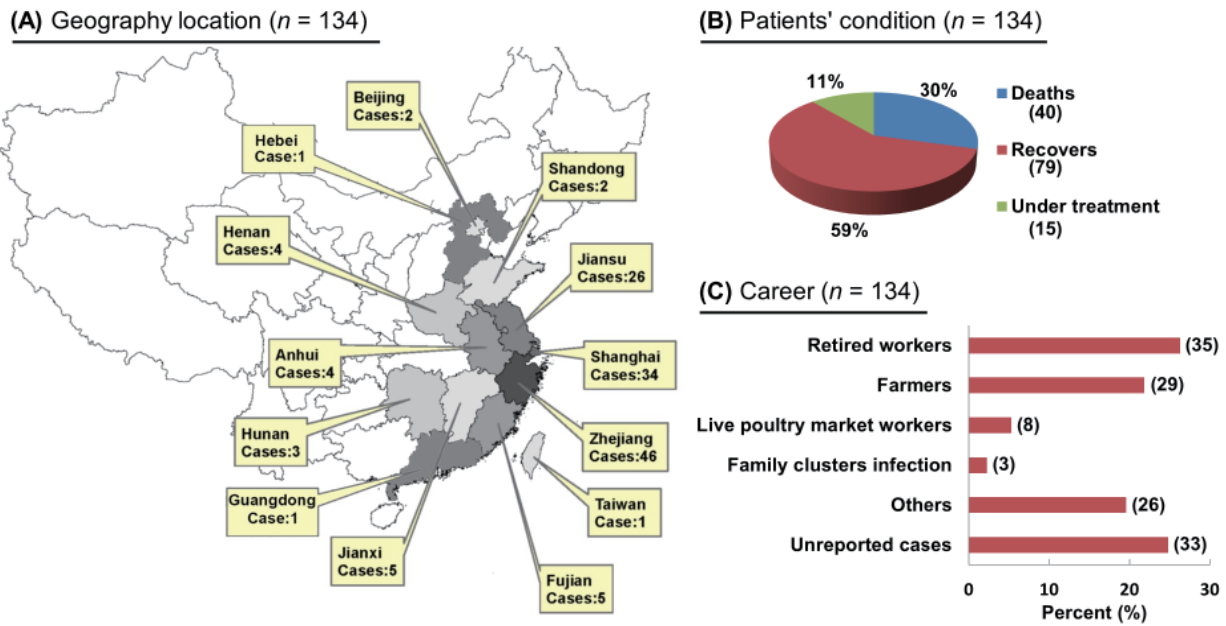
of the two new cases in China had a history of exposure to live animals in live poultry markets and were from the provinces where no case was reported during the period of spring of 2013, thus causing concerns in public that whether the virus will return in a more dangerous form and may spread to even more provinces in the near future?

From March 31 to May 31, 2013, 132 cases of human were infected with the H7N9 avian influenza virus in China, 39 of which were resulted in death (3,4), which sparked global concerns about public health. Fortunately, no new case was reported with H7N9 virus infection in China since May 8, and the emergency response to the event launched by Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Shandong, and Hu'nan of

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**Figure 1. Epidemiologic characteristics of 134 confirmed cases of human infection with H7N9 virus in China.** Data collection and analysis based on the information from weekly report on number of confirmed human cases of avian influenza A(H7N9) reported to WHO, the prevention and control work of human infection with avian influenza A(H7N9) by the National Health and Family Planning Commission (NHFPC) of China, and the epidemic reports from 13 provinces with infected patients in China during the period from March 31 to August 10, 2013.

China have been terminated, which seems like to make it step into a stable stage. However, the two new laboratory-confirmed cases emerged on July 20 and August 10 rung an alarm bell, thus, the continued public health response cannot let down its guard.

**2. The public health response to combat H7N9 virus infection in China**

Until now, 134 cases of H7N9 infection were reported in 43 cities of 13 provinces in China; most were in Zhejiang (46 cases, 7 deaths), Shanghai (34 cases, 13 deaths), and Jiansu (26 cases, 8 deaths) (Figure 1A and 1B). Based on experience fighting SARS, H5N1, and H1N1 outbreaks over the past ten years, China's public health response to H7N9 virus infection is faster and more effective in terms of transparency in reporting, surveillance, screening, and stockpiling of antimicrobials (5,6). Moreover, important information such as viral gene sequence data and patient information were shared in a timely manner within China and with the international community *via* the WHO under International Health Regulations (7).

After the outbreak of infection with the H7N9 virus, China promptly initiated a survey of the virus' prevalence. In total, 84,444 specimens were collected from 473 live poultry markets, 32 poultry slaughterhouses, 896 poultry farms, 79 wild bird habitats, 36 pig slaughterhouses, and 137 environmental sampling sites. Results were announced by the Ministry of Agriculture of China on April 17 (8). This

results and the update information involving a total of 899,758 specimens announced on May 23 showed that Avian influenza (H7N9) viruses were only isolated in samples from "wet" poultry markets and wild pigeons but not from poultry farms, wild bird habitats, or slaughterhouses (8,9). From April 18-24, a joint team of international and Chinese influenza experts convened by the WHO visited poultry markets and neighborhoods in Shanghai where infections were reported to assess the prevalence of H7N9 in China (10). Results indicated that the risk of H7N9 infection stemmed from live poultry markets and that people could be infected through contact with virus-carrying birds or exposure to contaminated environments.

On April 29, a joint report on the environmental exposure risk at poultry farms from the Ministry of Agriculture and World Organization for Animal Health indicated that there were previously no cases of human or animal H7N9 infections. And virological data have indicated that the new H7N9 virus is a recombination of H7N3, H9N2, and the original H7N9 (11,12). Genetic recombination and key gene mutations have presumably occurred in poultry markets and in transit but not at poultry farms. Thus, there may be no pressing need for large-scale culling at henneries and sampling and inspection of poultry farms may prove adequate.

In this condition, focus on live poultry markets, active public health responses have been implemented in China, including closure of affected markets, halting the sale of fowl, thorough disinfection, poultry culling, and prohibiting the entry of exotic live poultry that

could benefit in preventing more people infected with H7N9 virus. Currently, closing live poultry markets is regarded as a major prevention measure in China.

### **3. Administration of live poultry markets in management of H7N9 virus infection: thorough closure or enhanced regulation?**

It is expected to avoid H7N9 virus infection at large if the live poultry markets could be closed thoroughly in the nationwide. However, it should be noted that nationwide thoroughly closing live poultry markets faces huge challenge in China. Currently, the measures of closing live poultry markets usually start to enforce after finding H7N9 virus positive samples in the affected market, just like the measures that have been implemented in affected areas such as Shanghai, and the measure are implementing in Hebei and Guangdong since the new cases were reported. Actually, as early as 2006, the Chinese Government have issued a regulation to direct live poultry markets to move out of densely populated areas in large and medium-sized cities and encouraging large cities to take the lead in prohibiting the sale and slaughter of live poultry in live poultry markets (13). But until now, a large amount of live poultry are still sold and slaughtered in markets, even in Shanghai, Jiangsu, and Zhejiang where most of the cases of H7N9 infection were reported.

Several studies have indicated that the greater risk factor for infection in urban residents is contact with virus-carrying birds or exposure to contaminated environments in live poultry markets. This risk is closely related to the habit of purchasing freshly slaughtered poultry. Changing live poultry purchasing habits will be difficult and take a long time. Correspondingly, thoroughly removing or closing live poultry markets face challenge and need a long time to solve it. So, due to the difficulty in changing live poultry purchasing habits and in thoroughly removing or closing live poultry markets in China, enhanced regulation of poultry markets will be a more feasible and effective strategy expected to be implemented. Such regulation would be expected to establish quarantine areas at production sites, establish fixed locations for slaughtering and quarantine, implement regular spot checks, implement bio-safety level disinfection, and establish better traceability of frozen poultry.

### **4. Other environments involving close contact with poultry: poultry handling, and living conditions in rural areas**

Beside the environmental exposure risk at live poultry markets and poultry farms, the environments involving close contact with poultry also exist in rural areas. According to available information on 134 laboratory-confirmed cases of H7N9 virus infection, 35 cases

involved urban retirees and 29 involved farmers (Figure 1C); most affected individuals had a history of exposure to live animals, and especially chickens.

In order to ascertain the relationship between poultry handling and avian influenza in rural areas, we conducted a cross-sectional study involving 1,379 participants in Shandong Province, Anhui Province, and the Inner Mongolia Autonomous Region from September 2007 to January 2008 (14). Results showed that the risk of environmental exposure to avian influenza is closely related to Chinese living conditions that influence poultry handling: of 1,379 participants, half had contact with wild birds ("often" and "occasionally"); nearly 50% have a semi-closed or open yard that poultry could pass through, 51% kept poultry in their homes. Some respondents had special chicken coops while others did not. Respondents who did not have special chicken coops instead had poultry that were raised in a common room, an extra room, or a restroom. Poultry feces were often found in the yard, living room, restroom, or kitchen of most homes with poultry and even in those with special coops. Thus, enhanced regulations on environmental health are needed for free-range poultry, especially in rural areas.

### **5. Conclusion**

The emerged two new laboratory-confirmed cases infected with H7N9 virus on July 20 and August 10 rung an alarm bell, thus, the continued public health response cannot let down its guard. Based on our before studies, we found that live poultry purchasing habits increase the risk of exposure to contaminated environments. Due to the difficulty in changing live poultry purchasing habits and in thoroughly removing or closing live poultry markets in China, we suggest that enhanced regulation of poultry markets would be a more feasible and effective strategy to fight against H7N9 virus infection in China. Such regulation would be expected to establish quarantine areas at production sites, establish fixed locations for slaughtering and quarantine, implement regular spot checks, implement bio-safety level disinfection, and establish better traceability of frozen poultry. Moreover, in view of the fact that frequent and inevitable contact between rural residents and poultry where rural residents lived also exists due to poultry handling and living conditions, the enhanced regulations on environmental health are also needed for free-range poultry, especially in rural areas.

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