**Laboratory and Epidemiology Communications**

**Laboratory Diagnosis and Epidemiology of Avian Influenza A (H7N9) Virus Infection in Humans in Nanchang City, China**

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An outbreak of human infection caused by an avian-origin influenza A (H7N9) virus was reported in China from February to May in 2013 (1). As of May 26, 2013, 132 cases of human infection with avian influenza A (H7N9) virus were confirmed in China, including 36 deaths. In comparison, previous human infections with H7 influenza viruses (H7N2, H7N3, and H7N7) primarily resulted in mild and self-limiting illnesses, whereas human infections with H7N9 resulted in severe and fatal respiratory diseases (2,3); therefore, H7N9 is of concern to public health.

Most H7N9 cases occurred in the Yangtze River Delta of China (1,2). Nanchang City, the capital of Jiangxi Province, is geographically surrounded by Anhui and Zhejiang Provinces and is very close to the Yangtze River Delta. The Nanchang Center for Disease Control and Prevention (NCCDC) initiated monitoring of the H7N9 subtype virus as a normal detection objective through the national influenza surveillance system on April 1, 2013. The present report is a summary of the incidence of 344 influenza-like illnesses and 79 suspected H7N9 human cases that occurred from April 1 to May 26, 2013 in Nanchang. In addition, personal contacts were investigated to obtain epidemiological information on the spread of the influenza A (H7N9) virus.

According to the National Network Disease Surveillance System of China for influenza, specimens positive for untypeable influenza A were routinely tested for influenza A (H5) by real-time RT-PCR. After the first three H7N9 cases were reported, the NCCDC also tested suspected cases according to the case definition of H7N9 surveillance (sudden onset of fever > 38°C, pneumonia, decreased leukocyte count or increased lymphocyte count, and failed antiviral therapy). Samples were tested by real-time RT-PCR in accordance with a protocol provided by the World Health Organization (WHO) Collaborating Center in Beijing.

Throat swabs or sputum samples were collected from suspected cases of influenza-like illness and sent to the influenza network laboratory of the NCCDC for detection of H7N9 by real-time RT-PCR. Real-time RT-PCR for influenza A and B viruses and subtyping of human influenza A (H1N1) and A (H3N2) have been described previously (4). Subtyping of the influenza A (H7N9) virus-positive samples was conducted according to a protocol provided by the WHO Collaborating Center for Reference and Research on Influenza (5). Of 344 influenza-like samples, 28 were positive for pandemic H1N1 2009, 2 for influenza A (H3N2), and 1 for influenza A (H7N9). Of the 79 samples isolated from suspected cases of H7N9 infections, 4 were positive for influenza A (H7N9), as confirmed by the Chinese CDC. In addition, 51 individuals in contact with the 5 human cases were negative for influenza A (H7N9) infection.

Five human cases (2 males and 3 females) of H7N9 infections were confirmed in Nanchang City from April 24 to May 7, 2013 (Table 1). As of May 19, 4 of these patients had completely recovered, whereas the fifth

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**Table 1. Detection and Epidemiological Investigation of H7N9 Human Cases and Close Contacts in Nanchang of China**

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Sex</th>
<th>Age (yr)</th>
<th>Occupation</th>
<th>Area</th>
<th>Exposure to poultry</th>
<th>No. of close contact</th>
<th>No. of ILI symptoms</th>
<th>No. of positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>69</td>
<td>Peasant</td>
<td>Qingshanhu district</td>
<td>Yes</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>76</td>
<td>Peasant</td>
<td>Nanchang county</td>
<td>Yes</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>80</td>
<td>Peasant</td>
<td>Qingshanhu district</td>
<td>Yes</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>31</td>
<td>Retailer (peasant)</td>
<td>Nanchang county</td>
<td>Yes</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>79</td>
<td>Peasant</td>
<td>Nanchang county</td>
<td>Yes</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

1) This close contact is Case 4's husband who had cough and running nose on April 28.
2) Throat swabs from contact were tested by real-time RT-PCR.
3) No. of close contact.

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The median age of the H7N9-infected patients in Nanchang City was 65 years (range, 31–80), and most (n = 4) were aged over 65 years. Epidemiological data showed that all cases had a history of exposure to poultry during the 7 days prior to symptom onset and 3 cases (Cases 2, 3, and 5) had a long history of household poultry breeding. Environmental samples from these breeding sites were all negative for influenza A (H7N9); however, 2 of 7 environmental samples from a live poultry market that 1 patient (Case 1) visited approximately every 2 days were positive for influenza A.
(H7N9). In contrast, 14 poultry retailers (age range, 30–45 years) who shared a common space in a market were negative for influenza A (H7N9). An additional patient (Case 4) was a retailer in a small farm product market where live poultry was sold (7–8 m away from Case 4).

The cases were concentrated to 2 in suburban districts of Nanchang City, 3 in Nanchang county, and 2 in Qingshanhu District (Fig. 2). In addition, middle-scale and small-scale poultry farms were concentrated in the suburbs of these 2 areas. Furthermore, many peasants had long histories of household poultry breeding in Nanchang county. The initial symptoms of these 5 cases were fever (axillary temperature >38°C; n = 5), cough (n = 3), headache (n = 2), weakness (n = 4), nasal obstruction and runny nose (n = 1), expectoration (n = 1), pruritic body rash (n = 1), chest tightness (n = 2), and nausea (n = 1). Of the 5 cases, 3 developed severe pneumonia and 2 developed respiratory failure 3–8 days after symptom onset. Two cases had low leukocyte counts (2.2–3.5×10^9 cells/L), while the others had leukocyte counts within the normal reference range (4.0–10.0×10^9 cells/L).

The samples were primarily collected from a local sentinel hospital of the National Influenza Surveillance System of China, and suspected cases were reported by hospitals in the region around Nanchang City. On April 24, 2013, an influenza-like illness case was positive for influenza A (H7N9). We immediately reported this to the local health authority and Jiangxi Provincial Center for Disease Control and Prevention, who initiated a level IV emergency response. A total of 79 suspected human cases were reported and 4 (5.1%) of these were positive for influenza A (H7N9) infection by May 26, 2013. As of May 19, 4 cases recovered 12–28 days after symptom onset; these cases likely benefited from the administration of a therapeutic regimen. Oseltamivir treatment (75 mg twice a day for 7 days) played a very important role in the recovery of the patients infected by the influenza A (H7N9) virus. However, 4 patients, except Case 2, were supported by endotracheal intubation and mechanical ventilation due to progressive hypoxemia or respiratory failure.

Previous studies suggested that several mutations in hemagglutinin may be involved in the acquisition of the ability to infect humans by the influenza A (H7N9) virus (6), and genetic evidence indicated that poultry is the reservoir of the virus (7,8). However, preliminary observations also indicated that not all patients had a history of poultry exposure, which raised questions regarding the source and transmission route of the influenza A (H7N9) virus (2).

The transmission source and route of H7N9 remains unclear at present. However, the present study provided epidemiological evidence to support the hypothesis that poultry is a potential transmission source of influenza viruses. In addition, test results of 51 close contacts indicated that human-to-human transmission was limited. However, elucidation of the source and mode of transmission of these infections will require further surveillance, and appropriate counter measures are urgently required.

To date, the epidemiology of H7N9 infections in humans has revealed that most symptomatic patients are older (median age, 61 years) and have underlying medical conditions. In comparison, among the 45 avian influenza A (H5N1) cases reported in China from 2003 to 2013, the median patient age was 26 years (9). This difference in median age may represent actual differences in exposure or susceptibility to H7N9 infection and clinical illness; however, the identification approaches of suspected cases may be more likely to identify older patients (10). Nonetheless, ongoing surveillance and case-control studies are needed to better elucidate the epidemiology of H7N9 virus infections and to determine whether younger persons may be more mildly affected and therefore less likely to be detected via surveillance. In conclusion, continued surveillance of H7N9 infections and early diagnosis and treatment are essential to control and prevent further transmission in the near future.

**Conflict of interest** None to declare.

**REFERENCES**