Announcements
World Suicide Prevention Day — September 10, 2020

Key Statistics
Suicide Mortality — China, 2018

Preplanned Studies
Effects of Varicella Vaccine Time of First Dose and Coverage of Second Dose — Beijing and Ningbo, China, 2012–2018

Notes from the Field
A Detected Case of Avian Influenza H9N2 from Influenza-Like Illness Surveillance — Hunan Province, 2020

Perspectives
Harmonizing the COVID-19 Pandemic Response with Economic and Social Recovery

Profiles
Liubo Zhang, China CDC’s Chief Expert of Disinfection
China CDC Weekly

Editorial Board

Editor-in-Chief  George F. Gao
Deputy Editor-in-Chief  Liming Li  Gabriel M Leung  Zijian Feng
Executive Editor  Feng Tan

Members of the Editorial Board

Xiangsheng Chen  Xiaoyou Chen  Zhuo Chen (USA)  Xianbin Cong
Gangqiang Ding  Xiaoping Dong  Mengjie Han  Guangxue He
Xi Jin  Biao Kan  Haidong Kan  Qun Li
Tao Li  Zhongjie Li  Min Liu  Qiyong Liu
Jinxing Lu  Huiming Luo  Huilai Ma  Jiaqi Ma
Jun Ma  Ron Mooienaar (USA)  Daxin Ni  Lance Rodewald (USA)
RJ Simonds (USA)  Ruitai Shao  Yiming Shao  Xiaoming Shi
Yuelong Shu  Xu Su  Chengye Sun  Dianjun Sun
Hongqiang Sun  Quanfu Sun  Xin Sun  Jinling Tang
Kanglin Wan  Huqing Wang  Linhong Wang  Guizhen Wu
Jing Wu  Weiping Wu  Xifeng Wu (USA)  Zunyou Wu
Fujie Xu (USA)  Wenbo Xu  Hong Yan  Hongyan Yao
Zundong Yin  Hongjie Yu  Shicheng Yu  Xuejie Yu (USA)
Jianzhong Zhan  Liubo Zhang  Rong Zhang  Tiemei Zhang
Wenhua Zhao  Yanlin Zhao  Zhijie Zheng (USA)  Maigeng Zhou
Xiaonong Zhou  Baoping Zhu (USA)

Advisory Board

Director of the Advisory Board  Jiang Lu
Vice-Director of the Advisory Board  Yu Wang  Jianjun Liu

Members of the Advisory Board

Chen Fu  Gauden Galea (Malta)  Dongfeng Gu  Qing Gu
Yan Guo  Ailan Li  Jiafa Liu  Peilong Liu
Yuanli Liu (USA)  Roberta Ness (USA)  Guang Ning  Minghui Ren
Chen Wang  Hua Wang  Kean Wang  Xiaoqi Wang
Zijun Wang  Fan Wu  Xianping Wu  Jingjing Xi
Jianguo Xu  Gonghuan Yang  Tilahun Yilma (USA)  Guang Zeng
Xiaopeng Zeng  Yonghui Zhang

Editorial Office

Directing Editor  Feng Tan
Managing Editors  Lijie Zhang  Qian Zhu
Scientific Editors  Ning Wang  Ruotao Wang
Editors  Weihong Chen  Yu Chen  Peter Hao (USA)  Xudong Li
         Jingxin Li  Xi Xu  Qing Yue  Ying Zhang

Cover Image: Adapted from www.iasp.info/wspd
The World Health Organization (WHO) states that suicide is a major public health problem that accounts for approximately 1 million deaths globally every year (1). The Global Burden of Disease (GBD) study in China estimated that self-harm was the ninth leading cause of years of life lost (YLLs) in 1990 and was the thirteenth in 2017 (2). WHO statistics showed that suicide is the second leading cause of death in the group aged 15–29 years old (3).

The International Association for Suicide Prevention (IASP) is a non-governmental organization which dedicated to preventing suicide and suicidal behavior, alleviating its effects, and providing a forum for academics, mental health professionals, crisis workers, volunteers and suicide survivors (4).

World Suicide Prevention Day (WSPD) on September 10 each year aims to raise awareness of suicide and suicide prevention. Inaugurated in 2003 by the IASP in collaboration with WHO, thousands of individuals and organizations from over 70 countries by 2019 participated in local WSPD seminars, fundraisers, walks, and other activities (4).

The theme for 2020 is “Working Together to Prevent Suicide”, which emphasizes the need for collaboration between community-based organizations and governmental organizations to reduce suicidal behavior.

doi: 10.46234/ccdcw2020.191

Submitted: August 31, 2020; Accepted: September 01, 2020

REFERENCES

In this study, the data of 16,824 individual suicide deaths were collected by the Disease Surveillance Points System (DSPs) and estimated to investigate characteristics of suicide deaths in China in 2018. Detailed descriptions of DSPs have been reported elsewhere (1). These data on suicide deaths were stratified by gender, area type (urban/rural), and region (eastern/central/western). The International Classification of Disease, 10th revision (ICD-10) was used to analyze methods of suicide by calculating the proportions of the various methods.

### TABLE 1. Crude mortality rate, adjusted mortality rate, and age-standardized mortality rate of suicide by gender, area, region, and age per 100,000 population in China, 2018.

<table>
<thead>
<tr>
<th>Items</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CMR</td>
<td>AMR</td>
<td>ASMR</td>
</tr>
<tr>
<td>Total</td>
<td>6.18</td>
<td>7.23</td>
<td>6.36</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>4.22</td>
<td>4.94</td>
<td>4.37</td>
</tr>
<tr>
<td>Rural</td>
<td>7.20</td>
<td>8.42</td>
<td>7.40</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td>5.51</td>
<td>6.44</td>
<td>5.51</td>
</tr>
<tr>
<td>Central</td>
<td>7.40</td>
<td>8.65</td>
<td>7.55</td>
</tr>
<tr>
<td>Western</td>
<td>5.56</td>
<td>6.51</td>
<td>6.10</td>
</tr>
</tbody>
</table>

Abbreviation: CMR=Crude Mortality Rate; AMR=Adjusted Mortality Rate; ASMR=Age-standardized Mortality Rate.

* Eastern: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan.
† Central: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan.
§ Western: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang (Tibet), Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

### TABLE 2. The distribution of suicide methods by gender, area, and region in China, 2018.

<table>
<thead>
<tr>
<th>Methods</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Urban</th>
<th>Rural</th>
<th>Male</th>
<th>Female</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisoning</td>
<td>43.62</td>
<td>40.85</td>
<td>47.61</td>
<td>33.89</td>
<td>46.58</td>
<td>41.50</td>
<td>44.41</td>
<td>45.37</td>
<td></td>
</tr>
<tr>
<td>Hanging</td>
<td>37.07</td>
<td>39.49</td>
<td>33.58</td>
<td>36.18</td>
<td>37.34</td>
<td>38.21</td>
<td>37.93</td>
<td>33.83</td>
<td></td>
</tr>
<tr>
<td>Drowning</td>
<td>5.01</td>
<td>3.91</td>
<td>6.60</td>
<td>4.89</td>
<td>5.05</td>
<td>5.66</td>
<td>4.84</td>
<td>4.33</td>
<td></td>
</tr>
<tr>
<td>Sharp force injury</td>
<td>3.54</td>
<td>4.25</td>
<td>2.52</td>
<td>4.36</td>
<td>3.29</td>
<td>2.51</td>
<td>3.39</td>
<td>5.38</td>
<td></td>
</tr>
<tr>
<td>Falls</td>
<td>9.52</td>
<td>10.02</td>
<td>8.80</td>
<td>18.88</td>
<td>6.67</td>
<td>10.71</td>
<td>8.27</td>
<td>9.79</td>
<td></td>
</tr>
<tr>
<td>Other methods</td>
<td>1.25</td>
<td>1.47</td>
<td>0.89</td>
<td>1.82</td>
<td>1.08</td>
<td>1.42</td>
<td>1.05</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: CMR=Crude Mortality Rate; AMR=Adjusted Mortality Rate; ASMR=Age-standardized Mortality Rate.

* Eastern: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan.
† Central: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan.
§ Western: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang (Tibet), Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

In this study, the data of 16,824 individual suicide deaths were collected by the Disease Surveillance Points System (DSPs) and estimated to investigate characteristics of suicide deaths in China in 2018. Detailed descriptions of DSPs have been reported elsewhere (1). These data on suicide deaths were stratified by gender, area type (urban/rural), and region (eastern/central/western). The International Classification of Disease, 10th revision (ICD-10) was used to analyze methods of suicide by calculating the proportions of the various methods. ICDs...
related to suicide included X60-X84 and Y87. The crude mortality rate (CMR) of suicide was calculated by using the number of suicide deaths and respective population. Considering underreporting, the mortality rate was adjusted through a formula: adjusted mortality rate (AMR)=crude mortality rate/(1−underreporting rate); the overall underreporting rate of injury (14.5%) was based on propensity score weighting established in a previous study (2). The Sixth National Population Census in 2010 was used for age-standardized mortality rate (ASMR) estimation (3).

**Source:** China Disease Surveillance Points System (DSPs).

**Reported by:** Shidi Meng; Jinlei Qi; Peng Yin; Jiangmei Liu; Maigeng Zhou, zhoumaigeng@ncncd.chinacdc.cn.

doi: 10.46234/ccdcw2020.192

Submitted: August 25, 2020; Accepted: September 01, 2020

### References


Effects of Varicella Vaccine Time of First Dose and Coverage of Second Dose — Beijing and Ningbo, China, 2012–2018

Yuewei Chen; Rui Ma; Yunyan Zhang; Xudong Li; Dapeng Yin

Summary
What is already known about this topic?
The effectiveness of the two-dose vaccination schedule of varicella is better than that of one dose, but the vaccination schedule and coverage of varicella varies based on provinces in the mainland of China and has differing effects.

What is added by this report?
Earlier vaccination of the first dose may reduce the varicella incidence, and improving the vaccination coverage rates of the second dose will further reduce the varicella incidence.

What are the implications for public health practice?
Taking the first dose of vaccination promptly at 12 months old and improving the coverage of second dose of vaccination may play an important role in varicella prevention and control in China.

Varicella-zoster virus (VZV) is a highly contagious herpesvirus that can cause varicella (chickenpox) in children and herpes zoster (shingles) in adults, and most people would become infected by mid-adulthood in the absence of a varicella vaccination program (1). Epidemiological data on varicella is needed before the vaccine can be included into China’s Expanded Program on Immunization (EPI).

The timing of administering the vaccination is crucial for controlling the spread of varicella, but the mainland of China lacks a uniform schedule for these vaccinations. This study compared Beijing and Ningbo of Zhejiang Province to analyze the differences in varicella incidence when compared to different vaccination schedules for the first dose and different coverage of the second dose.

After 2007, Beijing and Ningbo have required the compulsory reporting of varicella incidence through the National Notifiable Diseases Reporting System (NNDRS) of the mainland of China. The epidemiological data from regions where compulsory reporting had been implemented provide some valuable information, and all the data in this paper is from the NNDRS (2007–2018).

Beijing and Ningbo are developed areas in the mainland of China. The immunization program and infectious disease surveillance of the two cities are well organized and their data on varicella is comparatively higher quality within China (2–4). A two-dose immunization schedule is recommended in the two cities with little difference for the first dose. The first dose of vaccine was set to be administered at 18 months of age in Beijing starting in 2007 and 12–18 months in Ningbo starting from 2012. The second dose was set to be administered at 4 years of age in Beijing since 2012 and Ningbo since 2014. The varicella inoculation rate for the first dose is higher than the second dose and the inoculation rate for Beijing is higher than Ningbo. (Figure 1)

There is a noticeable difference in varicella incidence in age group 1 (12 to 24 months) in the two cities with the incidence in Beijing being much higher than that of Ningbo. In Beijing, the incidence in age group 1 initially increased and then declined slightly, but Ningbo had a relatively low incidence without significant changes. (Figure 2)

After the implementation of the two-dose schedule in Beijing from 2012, the total population incidence decreased significantly but increased slightly after 2016. Ningbo also showed decreases after introducing the second dose of vaccine in 2014 but had dramatic increases after 2016.

Further analysis of the incidence of the sub-age group 0 years old to 15 years old in Ningbo reveals a prominent increase for the age group of 9 years old to 10 years old (from 9 years old to 14 years old) after 2014 (Figure 2), and the peak incidence of Ningbo is backward from 4–8 years old in 2012, to 9–13 years old in 2018 (Figure 3).

DISCUSSION

Most population-based data on the epidemiology of varicella are from high-income countries, data from
low-to-middle income countries are comparatively limited (1). The epidemiological data of Beijing and Ningbo in the mainland of China can provide some useful information for the preparation of vaccine immunization strategies in China. The epidemiological profiles of varicella in the two cities are different as are the immunization schedules, surveillance requirements, and immunization coverages.

This investigation reported a comparative study of the varicella vaccination in Beijing and Ningbo based on policies and coverage by year, and associating the policies and coverage levels with the incidence of varicella in the two cities.
varicella by age and by year. The research analyzed the possible reason of the higher varicella incidence of Beijing compared with that of Ningbo among age group 1 (12–24 months). The difference may not emerge from baseline data differences because the incidence in both cities is similar in age group 0 (0–12 months) (Figure 2). However, a likely reason is the difference in the time of administration of the first dose of the varicella vaccine. While the administration of the first dose is recommended at 12–18 months of age by the World Health Organization (WHO) (1), the time of the first dose in the mainland of China varies between regions. For instance, the time of vaccine administration in Beijing is set at 18 months, while Ningbo is set at 12–18 months. The first dose of vaccination being set at the age of 18 months may cause a susceptible population of children aged 12–18 months to miss an earlier immunization.

The total incidence of varicella under 15 decreased from 2012 in Beijing and slightly increased after 2016 (2) after the two dose schedule was introduced into the local program. Similarly, after the two-dose schedule was administered after 2014 in Ningbo, the incidence decreased and increased noticeably. This may be due to the coverage of the second dose being lower in both Beijing (39.79%–70.54%) and Ningbo (40.63%–54.01%). The coverage of second dose in both areas did not reach the 85% threshold that was recommended by the WHO to establish herd immunity (5). In addition, the issue of breakthrough infections exists in which a vaccinated individual becomes sick from the illness the vaccine was meant to prevent, and a high incidence of breakthrough cases has appeared in children aged 3–6 years old (6). Therefore, after a second dose of vaccine in 2012 for Beijing, there may have been some breakthrough cases after 2015.

By comparing the incidence of varicella in different age groups between Beijing and Ningbo (Figure 3), we can find that the incidence of almost every age group decreased dramatically from 2012 in Beijing. But for Ningbo, the age of peak incidence was changed from 4–8 years old in 2012 to 9–13 years old in 2018. This is likely due to the vaccine coverage in Ningbo being much lower than that of Beijing, which may cause many susceptible cases to accumulate. The WHO and

FIGURE 3. The incidence of varicella by year from 2012 to 2018 in Beijing and Ningbo city, in China from age group 0 to 15. The incidence from 0 to 14 represents each year age group. The incidence of 15 age group represents the incidence of 15–19 years, respectively.
many countries have suggested that the introduction of widespread childhood varicella vaccination would decrease exposure to VZV in the population and result in an older age distribution of the remaining cases. Since complication rates in adults are higher than those in children, an increase in the peak age of infections could lead to increases in the overall morbidity even though the total number of cases would be reduced. This should be carefully monitored in Ningbo after the two-dose schedule was introduced into the local vaccine program.

This surveillance data can inform policy recommendations. The study results recommend lowering the age of first-dose vaccination in Beijing, paying attention to the increasing age of infection in Ningbo, and improving coverage of the second dose of varicella vaccine in Ningbo.

This study is subject to some limitations. First, the data was passively collected from the NNDRS and may be subject to underreporting that may lower the reporting rate of varicella. Second, this study was limited in scope to Beijing and Ningbo, so the effects of the two-dose vaccination schedule for varicella may not be generalizable to other cities or to China as a whole.

In conclusion, this paper analyzes the varicella data reported from the NNRDS. The most valuable information can be shared by local CDCs when combined with more detailed information on local varicella vaccination rates and vaccination management. As the incidence of varicella has been controlled to a relatively low level, decreasing the time of the administration of the first dose of the vaccine to 12 months of age may further decrease the incidence of varicella. Improving the coverage of second dose especially for the age 6–14 is important to control varicella in China.


* Corresponding author: Dapeng Yin, yindp@chinacdc.cn.

1 Office of Epidemiology, Chinese Center for Disease Control and Prevention, Beijing, China; 2 Ningbo Center for Disease Control and Prevention, Ningbo, Zhejiang, China; 3 Suzhou Center for Disease Control and Prevention, Suzhou, Jiangsu, China.

Submitted: March 12, 2020; Accepted: April 16, 2020

REFERENCES

A Detected Case of Avian Influenza H9N2 from Influenza-Like Illness Surveillance — Hunan Province, 2020

Siyu Zhang1,2; Chaoyang Huang1,2; Yingying Mo; Zhoujian Wu; Haizhen Li; Yiwei Huang1,2; Fuqiang Liu1,2; Lidong Gao1,2

Jishou Municipal Center for Disease Control and Prevention (Jishou CDC) received a phone call at 7:30 a.m. on April 24, 2020 from Xiangxi Tujia and Miao Autonomous Prefectural CDC (Xiangxi CDC) that avian influenza A/H9N2 virus was detected by quantitative reverse transcription-polymerase chain reaction (RT-PCR) from the throat swab sample of an influenza-like illness in an outpatient in the Xiangxi Traditional Chinese Medicine Hospital.

At 09:00 on April 24, the county and municipal CDCs carried out epidemiological investigations to show that the suspected case was found in a 5-year-old girl. At 03:00 on April 20, the girl developed initial symptoms of fever (37.3 °C), fatigue, abdominal pain, and nausea with vomiting 3 times, and the top body temperature during the course of the disease was 38.6 °C. In the morning of April 20, she was diagnosed with gastrointestinal cold in Xiangxi Traditional Chinese Medicine Hospital, and her throat swab samples were collected by the attending doctor. The fever disappeared by 17:00 the same day. On April 23, Xiangxi CDC carried out a RT-PCR test and the result illustrated that the patient was positive for avian influenza A/H9N2 virus, which verified by retesting on April 24. The patient was isolated to receive treatment in the hospital since April 25, and was released on April 30 based on the 2 consecutive negative results of RT-PCR test on April 28 and 29 (Figure1).

According to the investigation, the patient had no contact history with similar patients, live poultry, or poultry markets. On April 16, her grandmother bought a live duck from Stall 38 in a market and slaughtered it in Stall 14 before returning home to cook it. The patient’s parents and the attending doctor were judged to be close contacts and were placed under medical observation. On April 25, these 3 contacts were sampled and their RT-PCR test results were negative for avian influenza A/H9N2 virus. Up to May 6, none of them showed symptoms. Throat swab samples were collected from the patient’s grandparents and hosts of Stall 38, Stall 14, and adjacent stalls in the market and tested for avian influenza A/H9N2 virus, and all results were negative. About 30 live ducks were sold per day in Stall 38, and these ducks were bought from Huaihua City, Hunan Province. No more H9N2 cases were reported in Xiangxi and Huaihua by the end of May.

To identify the possible source of infection, 172

swab samples from live poultry’s throat and anus and 26 environmental samples from the market were tested by RT-PCR for subtype H9 influenza virus. A total of 101 live poultry swab samples and 10 environmental samples were influenza A H9 positive, including swabbed samples of cage surface in Stall 38, swabbed samples of chopping boards, and refuse water collected after cleaning poultry in Stall 14. Due to the lack of neuraminidase (NA) test kits, Xiangxi CDC could not identify whether the subtype H9 positive samples were N2 positive or not.

The full genomes of A/Hunan/11173/2020(H9N2) (HN11173/20) were sequenced. The unrooted phylogenetic tree was generated by the maximum likelihood method using Molecular Evolutionary Genetics Analysis (MEGA, version 7.0.26). The molecular phylogenetic analysis showed that the hemagglutinin (HA) and NA genes of HN11173/20 belonged to the A/Duck/HongKong/Y280/97(H9N2)-like lineage of Eurasian branch (Figure 2). The nucleotide sequences homology of 8 segments of HN11173/20 were analyzed with the online Basic Local Alignment Search Tool (BLAST) (Table 1), and matrix protein (M) segment was found to have highly homology with Human H7N9 strain isolated in Changsha (99.51%); polymerase acidic protein (PA) gene was 98.90% similar to that of H9N2 strain isolated from wildfowl (Accipiter gentilis schvedowi) in Tianjin. HA, NA, nucleoprotein (NP), nonstructural protein (NS), polymerase basic protein 1 (PB1), and polymerase basic protein 2 (PB2) segments were highly homologous with chicken H9N2 strains isolated from Guangdong Province, Shandong Province, and Shanghai Municipality.

The molecular characterization of the HN11173/20 strain were analyzed, whose critical amino acid residues in proteins were the same/similar to those of 3 strains of human H9N2 virus previously isolated from Hunan Province (A/Hunan/42088/2017(H9N2), A/Hunan/3728/2017 (H9N2), and A/Hunan/43517/2016 (H9N2)), as shown in the Table 2. The cleavage site of HA protein HAI and HA2 were SRSRRGL (H3 numbering 334–340), contained the basic amino acid arginine at positions 335 and 338 (R335, R338), which indicated low pathogenicity to poultry. The amino acid of the HA protein of this strain at positions 235–237 (H3 numbered 226–228) was LMG, which susceptibly binded to human-like α 2,6-linked sialic acid receptors and can effectively replicate in mammalian cells (7). NA protein were deleted at the stalk region (positions 63–65), and no oseltamivir associated resistance mutations in amino acid residues were found.

**DISCUSSION**

H9N2 influenza virus has low pathogenicity for birds, replicating mainly in the upper respiratory tract and causing mild or no overt signs of illness in specific pathogen-free (SPF) chickens (2). H9N2 infection is usual in live poultry and H9N2 contamination is common in poultry-related environment.

The first H9N2 avian influenza case in Hunan Province was found in 2013 (3). As of May 2020, 8 cases have been reported from ILI surveillance, and none had secondary cases. Only two patients had live poultry or live poultry market exposure history. The minimum age was 9 months old, and the maximum age was 15 years old. H9N2 avian influenza virus is most likely to attack minors and cause mild symptoms. Humans, especially exposed populations, are prone to infection.

The surveillance of influenza-like illness in sentinel hospitals played an important role in the discovery of human infected H9N2 virus. It is therefore necessary to strengthen the surveillance of sentinel hospitals and live poultry markets to monitor the spread of the influenza A viruses.

After analyzing the biomolecular characteristics of HN11173/20 strain, we observed the virulence of this isolate was relatively weak, and it had the characteristics of low-pathogenic avian influenza (LPAI) virus. The genome sequence analysis showed that the cleavage site of its HA was SRSSR↓GL, without multiple continuous basic amino acids insertion, which also conformed to the characteristics of the LPAI virus. HN11173/20 strain contained the amino acid leucine at position 226 in its HA receptor-binding sites, which had the characteristics to susceptibly bind to receptors of human cells and transmit directly from birds to humans causing mild flu-like symptoms. Online BLAST alignment showed that the M fragment of this strain had the most homology with H7N9 strain isolated from Changsha in 2017, suggesting that the reassortment of H9N2 and H7N9 could produce H7/H9 subtype avian influenza virus strains which could infect humans directly.

The prevalence of avian influenza viruses among
poultry and the emerging of sporadic human infected case pose a continuous threat to public health. This work reported a new avian influenza virus H9N2 infected case in Hunan Province. The phylogenetic features and the potential pathogenesis-related amino acid sites were analyzed. This work provided a pivotal reference for the understanding of the human infection of avian influenza viruses and points out the importance of the surveillance of the virus based on a One-Health strategy.

Acknowledgments: We thank the colleagues from the Chinese National Influenza Center, who isolated
and sequenced the full genome of A/Hunan/11173/2020 (H9N2).

doi: 10.46234/ccdcw2020.170

Corresponding authors: Fuqiang Liu, 88037558@qq.com; Lidong Gao, gldlj@hotmail.com.

1 Hunan Provincial Center for Disease Control and Prevention, Changsha, Hunan, China; 2 Hunan Provincial Key Laboratory of Microbial Molecular Biology, Changsha, Hunan, China; 3 Xiangxi Tujia and Miao Autonomous Prefectural Center for Disease Control and Prevention, Jishou, Hunan, China; & Jishou Municipal Center for Disease Control and Prevention, Jishou, Hunan, China.

& Joint first authors.

Submitted: June 20, 2020; Accepted: July 14, 2020

REFERENCES


### TABLE 1. Homology of 8 segments of HN11173/20 analyzed with the online Basic Local Alignment Search Tool.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Sequence length (bp)</th>
<th>The highest nucleotide identity of H9N2 virus in GenBank</th>
<th>Accession ID</th>
<th>Collection date</th>
<th>Collecting location</th>
<th>Identities</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA</td>
<td>1,742</td>
<td>A/chicken/China/C7/2018(H9N2)</td>
<td>MN384772</td>
<td>Jul-2018</td>
<td>Guangdong</td>
<td>98.50%</td>
</tr>
<tr>
<td>NA</td>
<td>1,442</td>
<td>A/chicken/China/63/2019(H9N2)</td>
<td>MN263217</td>
<td>05-Jun-2019</td>
<td>Shanghai</td>
<td>98.54%</td>
</tr>
<tr>
<td>NP</td>
<td>1,565</td>
<td>A/chicken/China/1103/2019(H9N2)</td>
<td>MN918142</td>
<td>20-Nov-2019</td>
<td>Shanghai</td>
<td>98.27%</td>
</tr>
<tr>
<td>NS</td>
<td>890</td>
<td>A/chicken/Shandong/3424/2016(H9N2)</td>
<td>MH667576</td>
<td>02-Jun-2016</td>
<td>Shandong</td>
<td>98.76%</td>
</tr>
<tr>
<td>MP</td>
<td>1,027</td>
<td>A/Hunan Changsha/26/2017(H7N9)</td>
<td>MF370250</td>
<td>04-Feb-2017</td>
<td>Hunan</td>
<td>99.51%</td>
</tr>
<tr>
<td>PA</td>
<td>2,175</td>
<td>A/Accipiter gentilis schwedowi/Tianjin/22/2017(H9N2)</td>
<td>MH114054</td>
<td>15-Jun-2017</td>
<td>Tianjin</td>
<td>98.90%</td>
</tr>
<tr>
<td>PB1</td>
<td>2,341</td>
<td>A/chicken/China/C7/2018(H9N2)</td>
<td>MN384772</td>
<td>Jul-2018</td>
<td>Guangdong</td>
<td>98.76%</td>
</tr>
<tr>
<td>PB2</td>
<td>2,339</td>
<td>A/chicken/Shandong/3424/2016(H9N2)</td>
<td>MH667576</td>
<td>02-Jun-2016</td>
<td>Shandong</td>
<td>97.52%</td>
</tr>
</tbody>
</table>

Abreviation: HA=hemagglutinin; NA=neuraminidase; NP=nucleoprotein; NS=nonstructural protein; MP=matrix protein; PA=polymerase basic protein.

* The date of this BLAST search was Jun 12, 2020.

### TABLE 2. The molecular characteristics of the H9N2 influenza viruses isolated from Hunan Province.

<table>
<thead>
<tr>
<th>Virus</th>
<th>HA (H3 Numbering)</th>
<th>NA (H2 Numbering)</th>
<th>M1</th>
<th>M2</th>
<th>NS1</th>
<th>PB1</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Receptor binding site</td>
<td>Cleavage site</td>
<td>156</td>
<td>183</td>
<td>190</td>
<td>226</td>
<td>227</td>
</tr>
<tr>
<td>A/Hunan/11173/2020(H9N2)</td>
<td>N N T L M G</td>
<td>SRSSRGL</td>
<td>Yes</td>
<td>I V D K P R N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The other three H9N2 viruses previously isolated from Hunan Province</td>
<td>N N T L M G</td>
<td>SRSSRGL</td>
<td>Yes</td>
<td>I V I D K P R N</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abreviation: N=Aspara; T=Threonine; L=Leucine; M=Methionine; G=Glycine; S=Serine; R=Arginine; I=Isoleucine; V=Valine; D=Aspartic acid; K=Lysine; P=Proline.
Harmonizing the COVID-19 Pandemic Response with Economic and Social Recovery

Jiao Wang; Xiaoming Shi

BACKGROUND

In recent months, Coronavirus Disease 2019 (COVID-19) has rapidly spread to the globe, and by July 16, 2020, it has led to more than 13.4 million confirmed cases and over 0.5 million deaths (1). The pandemic has imposed enormous pressure on the healthcare system. The proportion of severe cases was estimated to be 18.5% (38.9% for health care workers) by February 11, 2020 in China (2). Based on COVID-19 severity, Zhang et al. simulated the demand for medical resources in different scenarios (3) and found that the lack of an effective pandemic response could overwhelm the healthcare system and result in deterioration in the quality of healthcare services, in overstretching frontline healthcare workers, and in a high mortality rate. Therefore, healthcare systems in countries with limited medical resources and a severe pandemic are facing greater challenges. Indeed, the lack of preparedness was observed especially in the early stage of the COVID-19 pandemic, causing a surge in the number of infected cases and highlighting the importance of the pandemic response. Furthermore, clusters of cases were reported in various places and activities when effective pandemic response measures had not been developed. For example, 7 people were infected by the same confirmed case on a 2-hour bus ride (4) where no one wore a mask. Pung et al. investigated 3 clusters in Singapore and found that the clusters were related to either visits to shops/churches or participation in closed-door business meetings without maintaining a proper social distance (5). The cases illustrate the high risk that infections pose to economic and social activities and emphasize the importance of implementing necessary pandemic response measures during COVID-19.

An important prerequisite of reopening and recovery is adequate pandemic control capacity. Since COVID-19 pandemic risk worldwide might persist in the near future, pandemic management strategies should be based on balancing economic losses due to strict restrictions and health losses due to reopening and recovery.

RATIONALE AND EVIDENCE

The COVID-19 pandemic has had far-reaching impacts on the economy and society beyond the spread of the virus. The first quarter GDP of some countries contracted by 4.8%–6.8% (6–7). The Asian Development Bank estimated that the collective impact of the COVID-19 crisis on the global economy will be between $77–$347 billion (8). The International Labour Organization (ILO) of the United Nations (UN) expected a loss of working hours equivalent to 195 million full-time workers globally in the second quarter of 2020, making many workers face a loss of income and deep poverty (9). The decrease in income will in turn harm health of the workers in the future. In addition, persistent unemployment might lead to illness, marital strife, crime, and even suicide. As of April 22, COVID-19 has caused infections in at least 48 meatpacking plants and led to the closures of at least 17 facilities and triggering concerns about national meat supply in the United States (10). Although social distancing practices could effectively interrupt the transmission of COVID-19, they also put some countries and regions in a lockdown. In Turkey, the manufacturing industry has functioned far below its capacity because of COVID-19 (11). This lockdown in many countries and regions around the globe has become the worst recession since the Great Depression and the Global Financial Crisis (12). This period, also called the Great Lockdown, gave rise to racial discrimination, theft, violence, and other negative actions that disrupt the normal order of society, and even trigger diplomatic disputes. In countries where the spread of the pandemic was basically interrupted by strict isolation strategies and non-pharmaceutical measures, huge economic losses and impacts on production and life were observed. In the least developed countries, the socioeconomic
impacts further deteriorated poor health care infrastructure and drained limited resources to fight the crisis. Unfortunately, continued or intermittent social distancing may be extended to 2022 without other interventions (13). Therefore, there is an urgent need for reopening the economy under appropriate protective measures.

Lifting COVID-19 restrictions inappropriately may expose the public to a high risk of infection. Even though Republic of Korea gradually lifted restrictions following weeks of social distancing measures and careful surveillance, new clusters of 119 total cases were linked to nightclubs in Seoul in May 2020 (14). Due to the differences in the time of onset of COVID-19, pandemic responses, socioeconomic development levels, population density, public awareness, and environmental conditions, different countries and regions might be at different stages of the pandemic. A uniform approach could hardly meet the need for the recovery under the diverse conditions and pandemic stages, and may further hinder the economic and social recovery. Therefore, a region-specific, multilevel targeted risk management approach is proposed here to harmonize pandemic response with economic and social recovery amid the COVID-19 pandemic.

**RISK-BASED PANDEMIC MANAGEMENT STRATEGIES FOR ECONOMIC AND SOCIAL RECOVERY**

In order to prepare for economic and social reopening and recovery, a pandemic management strategy based on risk levels of individual regions or countries is proposed in Table 1. The local classification of risk levels should be based on a comprehensive consideration of confirmed cases, deaths, population density, climate conditions, and other factors that would provide rationality for risk-level classification. The risk-based pandemic management strategy recommended in this study was based on the risk adjusted pandemic response established by the National Health Commission of China because the curve of cumulative cases has been flattened since March in China without any sign of rebound, which implies that this strategy is effective in controlling the COVID-19 pandemic. However, it should be pointed out that it is difficult to apply one strategy to all countries and regions because of the significant differences in politics, economy, culture, health, and social management among countries. Therefore, reopening plans and pandemic response in other countries such as the United States, Republic of Korea, Singapore, etc. were also referred to improve the applicability of the management strategy. This study emphasized that the risk level plays an important role when countries formulate local strategies in order to harmonize the COVID-19 pandemic response with economic and social recovery. Under this principle, the specific situation of different countries and regions must be considered to explore differentiated strategies.

**TABLE 1. Region-specific risk levels and management strategies during COVID-19 pandemic.**

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Required Conditions for Each Risk Level</th>
<th>Risk Management Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>COVID-19 cases continuously decreasing for 14 consecutive days. Adequate hospital capacity and medical resource supply.</td>
<td>Prevent the spread of COVID-19 from external sources and resume work and normal life as soon as possible.</td>
</tr>
<tr>
<td>Medium</td>
<td>Growth of the number of new cases slows without evidence of a rebound.</td>
<td>Prevent the spread of COVID-19 from both external and internal sources with precautions. Orderly and conditionally resume work and normal life.</td>
</tr>
<tr>
<td>High</td>
<td>No downward trajectory of COVID-19 cases reported within 14 days or rebound reported.</td>
<td>Resumption is not recommended.</td>
</tr>
</tbody>
</table>

Reopening the economy strategically amid the pandemic is to mitigate the economic crisis caused by COVID-19. Priority should be given to essential industries such as medical supplies, energy, food, and emergency responses. The resumption of lower priority work could be appropriately delayed, particularly in high-risk regions. In most countries, tourist-dependent industries and retailers have been hit particularly hard by COVID-19. However, the pandemic is also an opportunity for emerging industries, such as telehealth and telemedicine, big data analytics, and mobile robotics, all of which have been showing strong growth potential.

Fiscal, monetary, and financial policies should be updated. They are supposed to support demand, incentivize firm hiring, and improve balance sheets to aid the recovery. Coordinated fiscal stimuli across countries with fiscal space would magnify the benefits.
Moratoria on debt repayments and debt restructuring may need to continue during the recovery phase. In areas with a high poverty level, the coordination of national tax policies should be improved and economic growth should be boosted to strengthen national health systems. Budget-constrained countries and regions could seek help from international financing facilities. Existing monetary arrangements and financial-sector regulations that hamper external competitiveness should be reformed to enable exchange-rate flexibility. Comprehensive new debt-relief schemes could be considered with good governance.

It is necessary to implement the employment priority policy and adjust the policy intensity according to employment situations. Employees in low-risk areas should be encouraged to return to work. Accordingly, employers should be encouraged to consider point-to-point transit services to reduce the infection risk in the public transportation systems. It should be pointed out that flexible employment through multiple channels favors the economy reopening. For unemployed people, online registration of unemployment and application for unemployment insurance are recommended to meet a basic living standard.

**LIFTING COVID-19 RESTRICTIONS CONDITIONALLY**

To coordinate with the conditional reopening of the economy, relevant COVID-19 restrictions should be lifted gradually. According to evolving risk levels, differentiated precautions should be taken based on local conditions. Some necessary living services and outdoor public places should remain operating or open during the pandemic in order to satisfy basic living requirements. In low-risk areas, these places could gradually resume normal operations, though it should not be allowed in medium-risk areas until effective measures have been carried out to clean and disinfect the environment, monitor population health, limit population density, and reduce gatherings. Loosening restrictions will accelerate the flow of people. It is recommended to ensure a seamless and hermetic process for managing the quarantine and monitoring travelers particularly from high-risk areas in addition to strict management and supervision measures in public transportation stations and vehicles. Meanwhile, governments should protect agricultural production regardless of risk level. Since farmlands basically belong to open areas with ideal ventilation, inapplicable restrictions could be eliminated to ensure agricultural production and adequate food supply.

**DEVELOPING COMPREHENSIVE RECOVERY STRATEGIES**

In order to provide support for lifting restrictions and reopening the economy, it is critical to develop comprehensive recovery strategies for the mitigation, containment, and control of COVID-19. Different strategies have already been adopted by different countries and regions, such as testing, tracing, and supported isolation (TTSI) adopted by the US, adaptive triggering strategy used by the UK, and the risk-adjusted strategy adopted by the WHO Western Pacific Region. Early detection, early reporting, early isolation, and early treatment are recommended to control infection sources and interrupt the transmission route. In low-risk areas, normal health care services, such as outpatient care, emergency clinic, hospitalization, and surgery, should be fully resumed. In medium-risk areas, they should be resumed in an orderly manner while taking necessary precaution measures. In high-risk areas, hospital capacity should be surged and health institutions should also focus on research and development of effective drug and vaccines. Compliance with strict preventive measures should be improved especially for vulnerable groups. Psychological services should also be provided for patients, family members of patients or deceased patients, and frontline health care workers to protect mental health and further promote social harmony and stability.

The COVID-19 pandemic may go far beyond an economic and social crisis and may become a health equity crisis. The failures in health equity may lead to long term existence of COVID-19 in communities. Thus, priority should be given to marginalized and vulnerable groups including children, older adults, refugees and migrants, poorer people, people with disabilities, people in detention, minorities, and lesbian, gay, bisexual, transgender, and intersex (LGBTI) people. These groups are more likely to be exposed to risks, more vulnerable to COVID-19 infection, and less likely to have the access to health care services and protective equipment. To cope with health inequity issues, inter-/intra-cooperation is encouraged to balance health resources in different countries and regions. In addition, the lack of community capacity and mobilization in the deprived
regions may be another key bottleneck to provide timely assistance to patients and their families (15).

**DISCUSSION**

Whether COVID-19 can be controlled or not is determined by the weakest health system and the most vulnerable groups in this interconnected world. In addition, different countries and regions are at various stages of the pandemic. Thus, a region-specific and multi-level targeted risk management approach should be emphasized while inter-/intra-national cooperation should be encouraged to formulate pandemic responses and accelerate the development of drugs and vaccines. With the occurrence of emerging infectious diseases, health concerns have become strategic issues related to national security. As the authorities dealing with health issues, health departments are suggested to provide technical support in coordinating with other relevant departments such as the market supervising departments, civil affairs departments, and agriculture departments. The implementation of a national strategy must be adjusted to satisfy local needs while local governments are recommended to develop flexible strategies harmonizing pandemic responses with social and economic recovery. Last but not least, although mortality rate of the youth is relatively low and the proportion of the asymptomatic cases is relatively high, infectious cases will indirectly increase the health risks to older adults. Therefore, compliance improvements across society is necessary to ensure the implementation of personal precautions during the pandemic.

**Acknowledgments:** The authors would like to acknowledge Prof. Zhiqiang Deng for insightful advices and help in improving the writing.

**Conflict of interests:** We declare no conflict of interests.

* doi: 10.46234/ccdw2020.171
* Corresponding author: Xiaoming Shi, shixm@chinacdc.cn.

---

1 China CDC Key Laboratory of Environment and Population Health, National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, China.

Submitted: July 08, 2020; Accepted: July 17, 2020

---

**REFERENCES**

Liubo Zhang, China CDC’s Chief Expert of Disinfection

Peter Hao1; Yu Chen1; Zhenjun Li1; Jingjing Xi1; Feng Tan1

Liubo Zhang is the Chief Expert of Disinfection of China CDC and has been devoted to public health and preventive medicine since graduating from Wuhan Medical College in 1983. Over the past 37 years, he has been engaged in many fields such as epidemic control, infectious disease prevention and control, and disinfection and hospital infection control. Especially in the past 20 years, he has made outstanding contributions to these fields. Zhang has participated in the prevention and control of major infectious diseases such as the severe acute respiratory syndrome (SARS) epidemic and laboratory infections, human infection with highly pathogenic avian influenza, hand-foot-mouth disease, influenza A (H1N1), coronavirus disease 2019 (COVID-19), etc. He was responsible for the development of disinfection technical guidelines and on-site guidance for these diseases. He also participated in formulating on-site guidance of technical guidelines for the disinfection of major natural disasters such as the Wenchuan Earthquake, Zhouqu Mountain’s landslides, and Mozhu Mountain’s landslides in Xizang (Tibet) Autonomous Region. He has been awarded the titles of the “New Long March Assaulter of the Ministry of Health”, “Advanced Workers of the Ministry of Health”, and Merit Citation Class III of Hubei Province.

His work has not only been on the frontlines of domestic disease prevention and control but also on the international stage for rescues and epidemic prevention and control. In 2005, as a member of the Chinese Emergency Medical Team, he went to Indonesia to carry out post-disaster rescue abroad and was responsible for environmental disinfection and health protection of medical team members. In 2014, he went to Sierra Leone in West Africa as the chief disinfection expert to carry out Ebola hemorrhagic fever prevention and control work. Zhang used comprehensive and excellent professional technology to contribute to the prevention and control of the international epidemic and fulfilled his commitment to serve the people of Sierra Leone and to fulfill the national mission.

During the COVID-19 pandemic, he led his team in the prompt development of more than 50 personal protection and scientific disinfection technical guidelines, 13 of which were adopted and officially released by the State Council’s Joint Prevention and Control Mechanism or the National Health Commission (NHC, formerly the Ministry of Health). Zhang provided an expert’s perspective through informing decisions and technical advice. He provided assistance to the State Council, the NHC, the Ministry of Industry and Information Technology, the Ministry of Public Security, the Ministry of Environmental Protection, the Civil Aviation Administration of China, and the National Railway Administration to solve problems such as the shortage of protective clothing and masks, hospital sewage treatment, protection and disinfection of special places and special populations, and the optimal use of disinfectants.

His proposals of “disposable protective clothing in isolation wards, excluding ICU isolation wards, should not consider microbial indicators” and the emergency marketing of some disinfection products were adopted and effectively alleviated the shortage of protective and disinfection materials in the early stages of the pandemic. Facing the phenomenon of excess disinfection, he issued a scientific disinfection proposal to promote the concept of “precision disinfection”. He was interviewed by authoritative media and the Press Conference of the Joint Prevention and Control Mechanism of the State Council to publicize and popularize the scientific and precise prevention and control of COVID-19. Especially in the response to COVID-19 in Beijing, Liubo Zhang, as a member of the NHC’s expert group and the Chief Expert of the Beijing Municipal Government’s working group in Fengtai District, worked on-site for one month. He focused on guiding the on-site environmental cleaning, proper disposal, evaluation of the effects of disinfection, etc. At the city’s regular meeting on COVID-19 prevention and control, he was praised by the leaders of the Beijing Municipal Government four times and was fully affirmed by the leaders of the NHC for his outstanding performance.
The national hospital disinfection and infection control monitoring system he established has been in operation for more than 10 years and currently covers 32 provinces, cities, districts, and cadres across the country. It has accumulated a large amount of data for the prevention and control of infectious diseases and hospital infection control and promoted the development of hospital disinfection and infection control. As the first person in charge or sub-project leader, Zhang has presided over more than 10 national, provincial, and ministerial research projects and more than 10 special projects on disease control. The method “carrier flow immersion disinfection test” he studied was listed as one of the basic methods in the “Disinfection Technical Specification (2002 edition)”. He led his team to a lot of breakthroughs, including the pressure steam sterilizer Bowie-Dick test (BD) and microbial resistance test system, and the hydrogen peroxide plasma sterilizer microbial resistance test device, the first establishment of cleaning effect evaluation laboratory for medical cleaning agents in China. Zhang led the drafting of 9 national standards, worked as 1 of 3 major individuals in charge of drafting 28 national standards and hygiene industry standards, and participated in the drafting of 21 national standards. He published more than 10 books on disinfection as Editor-in-Chief or Deputy Editor-in-Chief and published more than 50 articles in domestic and foreign magazines as the first author or corresponding author.

Liubo Zhang, as the Chief Expert of Disinfection, always promptly arrives at the scene of an epidemic or disaster to conduct on-site guidance and the development of disinfection technical guidelines. Wherever there is a catastrophe or an epidemic, he is there. He is a disease control fighter who is active on the front line of guarding the lives and health of the people and is also a leader in guiding the rapid development of disinfection in China.


* Corresponding authors: Jingjing Xi, xijj@chinacdc.cn; Feng Tan, tanfeng@chinacdc.cn.

1 Chinese Center for Disease Control and Prevention, Beijing, China; 2 National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, China.

* Joint first authors.

Submitted: August 24, 2020; Accepted: August 31, 2020