

# The influenza viruses in China: Pandemic and prevention measures

**Yifei Du**

Preventive Medicine, Shihezi University, Xinjiang Uygur Autonomous Region,  
832061, P.R.China

20201014824@stu.shzu.edu.cn

**Abstract.** Seasonal influenza (SI) is a kind of respiratory virus with annual epidemic and high contagion, leading to cause increased morbidity and mortality in certain population. According to estimates, the flu causes an average of 400,000 respiratory deaths per year worldwide. The estimate mortality of flu is more than 65 per 100,000 people in the worldwide, and the ratio is 52.9/100,000 in China, demonstrating that seasonal influenza has caused a considerable disease burden in China. Influenza viruses are spread by droplets, and people infected with seasonal influenza usually have a sudden high fever, dry cough, and severe headache. Noteworthy, children and gravidas have higher rates of infection, and the elder population over 65 ages has a higher risks for complications, hospitalizations and death, especially patients with cardiovascular and pulmonary diseases. Therefore, prevention and treatment of high-risk populations is important to prevent and control influenza, while vaccination is an effective solution to protect them from infection and associated complications. In this paper, the author analyzes the epidemic features of influenza viruses in different regions of China in light of the prevention and control policies in various places, and provides some suggestions to prevent pandemic of influenza virus and enhance individual's preventive awareness, which purpose is to reduce the influenza positivity rate and the infection rate in the future, especially for vulnerable population of children and elder people.

**Keywords:** Seasonal Influenza, Epidemic, Prevention, Vaccine.

## 1. Introduction

Seasonal influenza (SI) is a kind of respiratory virus with annual epidemic and high contagion, leading to cause increased morbidity and mortality in certain population, especially in occasional pandemics. Influenza viruses include strains A, B, C, and D, and strain A virus, as the best known influenza virus, triggered the flu pandemic in 2009. Strain B viruses have less frequent antigenic variations in the genome, limiting themselves to break out and become seasonal influenza and epidemics rarely. Strain C viruses are antigenically stable and do not cause epidemics [1]. There are fewer studies related to influenza D viruses and further research is still needed.

At the end of 2019, novel coronaviruses are spreading around the world, causing a great global health burden. Since Influenza and SARS-CoV-2 share similar transmission pathway, epidemiologists are of the opinion that public health measures taken to prevent the spread of coronavirus also prevented the spread of influenza [2]. Nevertheless, even though the preventive policies during the New Crown period

have been effective in controlling the rate of influenza infection, there are still many problems with influenza prevention and control in China, such as the low rate of influenza vaccination, and the lack of attention to seasonal influenza by the nationals, and so on. In this paper, the author analyzes the epidemic features of influenza viruses in different regions of China in light of the prevention and control policies in various places, and provides some suggestions to prevent pandemic of influenza virus and enhance individual's preventive awareness, which purpose is to reduce the influenza positivity rate and the infection rate in the future.

## **2. Epidemic characteristics of influenza viruses**

Influenza virus mainly break out in winter at temperate zone, while it occurs at various times throughout the year in low latitude with high temperature locations. According to estimates, the flu causes an average of 400,000 respiratory deaths per year worldwide. The estimate mortality of flu is more than 65 per 100,000 people in the worldwide, and the ratio is 52.9/100,000 in China, demonstrating that seasonal influenza has caused a considerable disease burden globally [3].

Influenza viruses are spread by droplets, and people infected with seasonal influenza usually have a sudden high fever, dry cough, and severe headache. The majority of individuals recover within a week without severe clinical signs, sequelae or patient death. Noteworthy, children and gravidas have higher rates of infection, and the elder population over 65 ages has a higher risks for complications, hospitalizations and death, especially patients with cardiovascular and pulmonary diseases [4]. Therefore, prevention and treatment of high-risk populations is important to prevent and control influenza, while vaccination is an effective solution to protect them from infection and associated complications.

Although the disease cycle is short and generally does not lead to serious consequences, the highly contagious and mutable nature of influenza viruses still requires vigilance. As reported in a review study, the median basic reproduction number was 1.80 for the 1918 pandemic, 1.65 for the 1957 pandemic, 1.80 for the 1968 pandemic, 1.46 for the 2009 pandemic, and 1.28 for seasonal influenza [5]. As it spreads, influenza viruses accumulate mutations and then evolve through antigenic drift and antigenic transfer. Based on the above characteristics, epidemiologists suggest that it's necessary to stop transmission between one-third and one-half of infected population through public health measures, thus resulting in the reproductive number lower than 1, eventually leading to epidemic of this virus [5].

## **3. Epidemic characteristics of influenza viruses in China**

Recently, the incidence and serious complications of seasonal influenza has been reduced since the China government improved the public health system. Nonetheless, the spread of influenza viruses has resulted in a high economic burden of disease. The data from national statistics showed that there are 2.5 cases of influenza-like illness (ILI) diagnosed per 1000 individuals annually, and the total number of influenza-associated excess respiratory deaths is between 84,200 and 92,000 every year [6].

The obvious feature of influenza virus epidemics in China is regional differences, which is clearer to display their differences using high and low latitudes. In the high-latitude provinces, the epidemics are predominantly short and intense in the winter of each year, while in the mid-latitude and low-latitude provinces, the epidemics are known for their biannual outbreaks or year-round activity.

For example, the data from the Shihezi hospital from 2010 to 2021, which located in north China, the epidemic of influenza viruses mainly occurred in winter [7], due to the low temperatures. About ILI population, the highest population is aged 5-25 years and the lowest in the age group of 0-5 years [7] because of dramatic discrimination of vaccination and outdoor activity. Another example of hospital in Shanghai from 2010-2019, located in south China, the influenza broke out in winter and summer [8]. The reason of this difference is that high population mobility during the summer and winter tourist peaks increased the risk of virus transmission besides locations. Similar to the hospital in Shanghai, the data from hospitals in Guangdong and Hubei provinces during the period of 2018 to 2020, located far south China, there was a clear winter-spring epidemic peak and occasional summer epidemics of ILI% in the southern region [9, 10]. This phenomenon is related to the humid climate of the southern region is more

suitable for the multiplication of the virus in winter and spring, while the summer is mainly influenced by the lifestyle of southern residents.

Another feature is the main strain virus in both the southern and northern regions, alternating strain A viruses dominated the epidemic from 2018 to 2020, to influenza B viruses emerging as the epidemiologically dominant strain from 2021 (Table 1) [7, 8, 10].

#### **4. Prevention measures of influenza viruses in China**

A survey showed that strengthen the awareness, attitudes and knowledge are benefit to prevent and control influenza in south China. Therefore, there are some measures to prevent and control the pandemic of influenza virus, such as strengthen on prevention and control in densely populated places and high-risk groups, improvement of hygiene management in densely populated places, strictly disinfection environments with high population flow, implement random testing for early detection of patients with influenza, advocacy knowledge of influenza prevention and control awareness among exposed populations, and encouragement of adolescents and young adults to receive timely vaccinations to establish an immune barrier. Secondly, the sentinel hospitals are requested to conduct future surveillance by the definition of ILI and specimen collection requirements, and at the same time do a good job of sampling all age groups, especially the young children group and the high age group of over 60 years old [11].

In the northern region, a MEM model was proposed based on determining the baseline of influenza, and an LSTM model was established based on regional and demographic characteristics, while at the same time, a DLNM model was established to find the association between influenza and meteorological factors [12]. The government set up sentinel hospitals and applied these three models to monitor the ILI situation in real-time, and then uploaded them to the China Influenza Surveillance System promptly to provide theoretical support for influenza prevention and control efforts.

By comparing the epidemic prevention policies of the South and the North, it can be found that the influenza prevention focuses on group in south China through addressing the significance of prevention to raise the awareness of prevention, promoting ratio of vaccination to enhance the immunity of the population, eventually achieve the purpose of lowering the infection rate of the population and controlling the spread of diseases. In north China, the prevention measures are be taken in advance of the spread of the virus through monitoring on meteorological factors, studying patterns of climate change during influenza outbreak periods, and analyzing and predicting the epidemic models using software.

What is certain is that China governments are learning lessons and experiences to deal with the epidemic of influenza virus from the 2019 New Crown Pneumonia epidemic [13], such as establishment of multi-surveillance systems, strengthen on influenza control and prevention among high-risk groups and in high-density population centers, as well as enhancement vaccination rate, especially focusing on novel vaccines development with the broad-spectrum and immunogenicity [4]. The introduction and implementation of a variety of measures have provided a fresh boost and positive effect in responding to the challenges posed by post-pandemic influenza.

It is worth noting that, an epidemic rebound usually occurs after a wave of epidemic outbreaks, due to being influenced by climatic conditions, viral antigenic evolution, and host (e.g. human) contact pattern. Individuals vaccination is effective in reducing the rate of infection and morbidity of seasonal influenza, especially for high risk population of children and elder people. At the same time, due to the high mutability of influenza viruses, the updating and applicability of vaccine development are also issues that need to be considered [13]. Besides, it is necessary to choose appropriate vaccines for different groups of people because some vaccines are applicable to most people and are suitable for short-term emergencies during pandemic outbreaks and some vaccines are more suitable for boosting the immune response of naïve people such as young people and children. Special adjuvants may even need to be added to enhance the effects of the vaccines for population with weakened immunity, such as the elderly [4].

In addition, drawing on the lessons learned and experience of the New Crown pandemic, real-time influenza surveillance to ensure that front-line healthcare workers are not infected, is crucial to ensure that hospitals have sufficient resources and strategies in place to meet the demand for additional healthcare resources [2]. Moreover, it is known that during the New Crown Epidemic period, the health code, with its practicality and convenience, made a great contribution to epidemic prevention and control, which can be applied to the monitoring of seasonal influenza. However, solutions need to be prepared in advance before being put into formal application due to the possible lack of credibility in filling in personnel information (Table 1).

**Table 1.** Epidemic characteristics of influenza viruses in China.

Area	Epidemic Characteristic	Countermeasures	Hidden Problems
North China	Mainly occurs in winter [7]	Epidemiological models analyzed and predicted by relevant agencies using software to develop epidemic prevention policies in real time [12]	Population lacks awareness of prevention to respond to flu in a timely manner
South China	Usually spreads in winter and summer [8]	Medical institutions establish herd immunity by popularizing vaccination, propagating knowledge of epidemic prevention [11]	Population immunization without vaccination policy support is less effective for influenza epidemic rebound
Far south China	Spreads in winter and spring, with occasional summer outbreaks [9]		

## 5. Conclusion

Seasonal influenza is an annual respiratory virus with highly contagious, which break out threaten health and life in some vulnerable population with higher morbidity and mortality. Therefore, a systematic monitoring system should be established to prevent the epidemic of influenza virus with government support. The education of prevention and vaccination should be carried out a population-based basis, with special protection strategies for high-risk groups. Improving the overall preventive awareness of the population and adherence to epidemic prevention policies can ensure the overall prevention and control of influenza, reduce the disease burden caused by influenza in China, strengthen the national physique, and help accomplish the ambitious goal of Healthy China 2030.

## References

- [1] Keilman LJ 2019 Seasonal Influenza (Flu). *Nurs. Clin. North. Am.* 2019 54(2):227-243.
- [2] Spantideas N, Bougea AM, Drosou EG, Khanderia N, Rai S 2021 COVID-19 and Seasonal Influenza: No Room for Two. *Cureus.* 13(9):e18007.
- [3] Paget J, Spreeuwenberg P, Charu V, Taylor RJ, Iuliano AD, Bresee J, Simonsen L, Viboud C 2019 Global Seasonal Influenza-associated Mortality Collaborator Network and GLaMOR Collaborating Teams. Global mortality associated with seasonal influenza epidemics: New burden estimates and predictors from the GLaMOR Project. *J. Glob. Health.* 9(2):020421.
- [4] Guillari A, Polito F, Pucciarelli G, Serra N, Gargiulo G, Esposito MR, Botti S, Rea T, Simeone S 2021 Influenza vaccination and healthcare workers: barriers and predisposing factors. *Acta. Biomed.* 92(S2):e2021004.
- [5] Ryu S, Cowling BJ 2021 Human Influenza Epidemiology. *Cold. Spring. Harb. Perspect. Med.* 11(12):a038356.

- [6] Feng LZ, Shay DK, Jiang Y, Zhou H, Chen X, Zheng YD, Jiang LL, Zhang QJ, Lin H, Wang SJ, Ying YY, Xu YJ, Wang ND, Feng ZJ, Viboud C, Yanga WZ, Yua HJ 2020 Burden of influenza-associated outpatient influenza-like illness consultations in China, 2006-2015: a population-based study. *Influenza Other Respir Viruses*. 14(2):162–72.
- [7] Wang KX, Zhang HW, Zhang PW, Zhen Q. Characterization of influenza epidemics in Shihezi City from 2010 to 2021. *Chinese Journal of Preventive Medicine*. 1-8.
- [8] Zhang JJ, Wu Aq, Liu M, Chen YF, Liu JY, Zhao Q. 2021 Characteristics of influenza-like illness epidemics and trend analysis in Xuhui District, Shanghai, China, 2010-2019. *Shanghai Preventive Medicine*. 33(12):1136-1140.
- [9] Xie MS. 2023 Characterization of influenza epidemics and analysis of viral antigenicity and genetic properties in Hubei Province from 2015 to 2019. *Wuhan University of Science and Technology*.
- [10] Liu Y 2023 Study on influenza epidemic characteristics and epidemic trend prediction in Guangdong during the new crown epidemic. *Guangzhou Medical University*.
- [11] Liu LL, Han S, Yu X, Li X, Ye GJ, Fang B. 2020 Analysis of influenza epidemic and pathogenicity monitoring in Hubei Province from 2016 to 2019. *Disease Surveillance*. 35(12):1105-1109.
- [12] Xu ZY 2023 Research and application of influenza early warning technology in Qinghai Plateau. *Qinghai University*.
- [13] Chen C, Liu GE, Zeng G. 2022 Current status, problems and challenges of influenza disease burden in China and strategies to address them. *China Public Health*. 38(11):1494-1498.