

Impact of China's COVID-19 prevention and control efforts on outbreaks of influenza

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SUMMARY The COVID-19 pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has resulted in a serious public health burden. As the COVID-19 epidemic in China would coincide with a seasonal outbreak of influenza, there were serious concerns about whether influenza would be aggravated by the SARS-CoV-2 infection and COVID-19 pandemic. This article provides a brief overview of the impacts of the COVID-19 epidemic on influenza activity in China. The percentage of positive influenza tests decreased during the COVID-19 pandemic. During the first stage of the COVID-19 outbreak, the percentage of positive influenza tests reached to a peak of 47.7%. At the second stage, the percentage of positive influenza tests was dramatically decreased from 40.4% to 14.0%. Thereafter, it remains at a low level of less than 6.2%. In addition, the possible causes of this phenomenon have been summarized, including prevention and control measures and ecological competition. Lastly, this article suggests that the public health approach to preventing COVID-19 may also help to control other respiratory infectious diseases. Public health measures need to be maintained even in the later stages of the COVID-19 epidemic.

Keywords COVID-19, SARS-CoV-2, influenza, co-infection, vaccines

1. Introduction

Outbreaks of influenza result in almost 650,000 respiratory-related deaths and millions of hospitalizations annually, and seasonal influenza has a significant impact on healthcare systems worldwide (1). In China, there were 88,100 annual deaths due to influenza in 22 provinces in 2010-11 and 2014-15 (2). To make matters worse, the outbreak of COVID-19, another respiratory infection that is causing a huge public health crisis in China, coincided with a seasonal outbreak of influenza in 2020. One study mentioned that influenza viruses might exacerbate COVID-19 (3). Thus, the question of whether a COVID-19 pandemic would exacerbate influenza has garnered attention worldwide.

2. Controversy on how the COVID-19 pandemic might affect the flu season

During the early stages of the COVID-19 pandemic, questions about how the COVID-19 pandemic might affect the flu season stirred up considerable controversy. Experts on one side argued that the COVID-19 pandemic might worsen influenza activity and, vice

versa, that influenza might exacerbate the COVID-19 pandemic. Support for this view comes from evidence that patients infected with both COVID-19 and influenza A have more severe disease progression and higher mortality (4,5), and recent experiments in mice have validated the ability of influenza A viruses to accelerate SARS-CoV-2's infection of the upper respiratory tract (6). In addition, the impaired host immunity, decreased influenza vaccination rates, and limited medical resources caused by the COVID-19 pandemic may all aggravate influenza.

Experts on the other side contend that public health measures such as social distancing, wearing masks, diligent hand washing, and measures taken to mitigate COVID-19 may help prevent influenza and reduce the burden of the upcoming flu season. In addition, they believe that effective public health measures to prevent COVID-19 could also help control other respiratory diseases, and not just influenza (7,8).

3. Influenza activity during the winter season in China from 2018-2021

A previous study that examined influenza activity during the COVID-19 pandemic noted a decline in

that activity in many regions, including the United States, Australia, Chile, and South Africa (9). Other studies compared influenza activity during the 2019-2020 flu season (from the outbreak of COVID-19 to March 29, 2020) and during the 2011-2019 flu season, and they found that non-pharmaceutical interventions reduced influenza activity in southern China by 79.2% in northern China by 79.4%, and in the United States by 67.2% (10,11). An abrupt subsidence of seasonal influenza was also observed in Hong Kong, China during the COVID-19 pandemic (12). Together, these findings indicate that influenza activity declined during the COVID-19 pandemic (13,14).

To further shed light on this result, the number of respiratory specimens tested for influenza in China during the winter season (December to the end of March) in 2018-2019, 2019-2020, and 2020-2021 has been summarized (15). Consistent with the previous findings, data from influenza surveillance sites in China indicated a clear decrease in the percentage of laboratory tests positive for influenza after the outbreak of COVID-19. Figure 1 shows that during the winter of 2020-2021, the percentage of positive influenza tests declined sharply during the winter flu season in China, almost 4 weeks earlier than the winter flu season of 2018-2019. Since then, the percentage of positive influenza tests has been zero. Even though the percentage of positive influenza tests declined sharply at the end of December and even in the first 4 weeks of 2020, the number of respiratory specimens tested for influenza during this period is on par with the number tested previously (Figure 2).

4. Possible explanations for the abrupt subsidence of outbreaks of influenza after the COVID-19 epidemic

The following are possible explanations for the abrupt subsidence of influenza outbreaks after the COVID-19

pandemic. According to the timeline for the spread of COVID-19 (16), influenza activity remained at a high level during the first stage of the COVID-19 outbreak before the outbreak of the disease in Wuhan, China. The percentage of positive influenza tests was fluctuated from 45.3% to 44.9%, and even reached to the peak of 47.7% one week after the appearance of COVID-19 cases. Even though respiratory specimen testing remained at the same levels in the first month after the appearance of pneumonia cases, the rate of positive results declined rapidly from 47.7% to 35.8%. One can reasonably assume that the decline in influenza activity may be related to ecological competition between the two respiratory viruses in the human upper respiratory epithelium, which may give rise to the emergence of COVID-19 as the dominant virus, thus reducing the rate of influenza virus infection (17-19).

More importantly, public health measures are thought to have been effective in reducing the burden of an influenza outbreak. Figure 1 shows that influenza activity declined dramatically. The percentage of positive influenza tests was decreased from 40.4% to 14.0% during the second stage of the COVID-19 outbreak in China, which is when prevention and control measures were implemented in response to COVID-19. During this period of time, individuals took basic COVID-19 prevention and control measures, including handwashing, wearing a mask, social distancing, and avoiding crowded places. Local governments implemented different policies depending on the level of risk of a COVID-19 outbreak in different areas. For example, high-risk areas were ordered to shut down cities, close schools and workplaces, and ban social gatherings to avoid large crowds and close contact settings while areas with a mid-level or low risk were advised to reduce public activities and to self-isolate (Figure 3) (19). Even though the basic reproduction number (R0) of COVID-19 may be higher

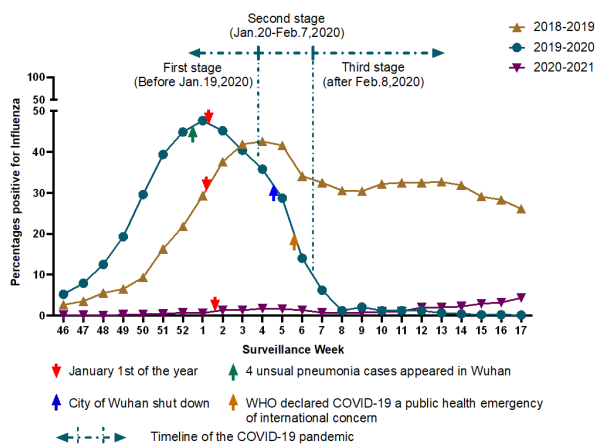


Figure 1. The percentage of positive influenza tests in China during the winter seasons (December to the end of March) from 2018-19, 2019-20, and 2020-21. Source: <http://www.chinaivdc.cn/cnic/en/>

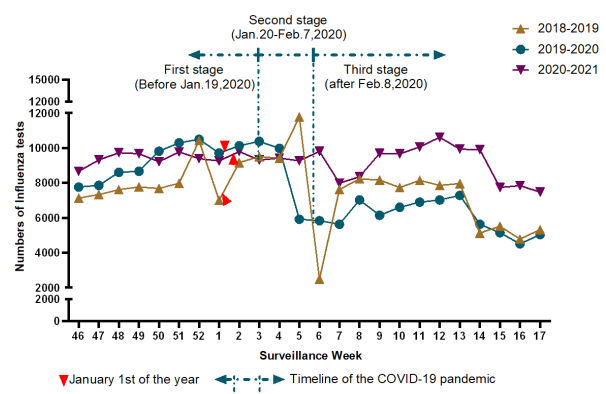


Figure 2. Number of respiratory specimens tested for influenza at Southern and Northern surveillance sites in China during the winter season (December to the end of March) from 2018-19, 2019-20, and 2020-21. Source: <http://www.chinaivdc.cn/cnic/en/>

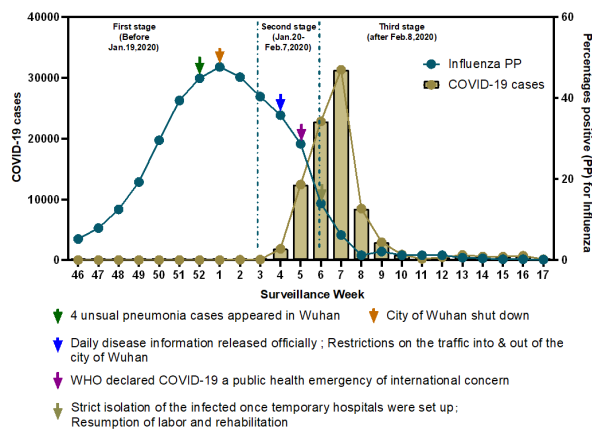


Figure 3. The percentage of positive influenza tests and COVID-19 cases in China during the winter season from 2019-2020. Key public health measures for the management of COVID-19 are indicated with arrows. Source: <https://covid19.who.int/region/wpro/country/cn>

than that of seasonal influenza, a substantial decrease in transmission could prevent excess deaths from the COVID-19 pandemic (20) since respiratory viruses are transmitted in similar ways and by similar routes. Thus, even if prevention and control measures may not have definitively reduced transmission, these findings greatly substantiate the hypothesis that public health interventions implemented to limit COVID-19 can reduce the burden of influenza pandemics.

The absence of influenza activity after the third stage of COVID-19 outbreak and the winter flu season of 2020-2021 further suggested that non-pharmaceutical interventions implemented to tackle COVID-19 also prevented influenza. Behavioral changes adopted in response to COVID-19, such as the wearing of a mask, social distancing, travel restrictions, and better personal hygiene, are still evident. Moreover, experience tracking COVID-19 has increased awareness of infectious disease prevention and control. Enhanced education and training for both healthcare personnel and the general public regarding personal hygiene and the public response to infectious diseases will also help to tackle the COVID-19 pandemic (21). In addition, the rate of influenza vaccination is on par with the previous rate, so vaccine efficacy and vaccination coverage may reduce the genetic drift or transfer of the dominant strain of influenza (21). Moreover, the surveillance of influenza was not inhibited by the COVID-19 pandemic but rather increased after COVID-19 was adequately controlled (Figure 2) (22).

In conclusion, the decline in influenza activity appears to be closely associated with public health measures that were implemented to control the COVID-19 pandemic. Public health measures taken by individuals, such as frequent hand washing, wearing of a mask, social distancing, and isolation of the infected, as well as policies adopted by governments, including stronger laws on infectious diseases, stricter

quarantines, and restrictions on public activities in high-risk areas, have played a crucial role not only in defending against COVID-19, but also in combating influenza activity. This finding prompts careful consideration of the positive role of effective public health measures during the COVID-19 pandemic or even in the management of respiratory infectious diseases in the future. Thus, public health measures need to be maintained even in the aftermath of the COVID-19 pandemic.

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