

Research on Airport Epidemic Prevention and Control Strategies from the Perspective of New Crow

-- Take the Epidemic Situation at Nanjing Lukou International Airport in 2021 as an Example

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Abstract

By analyzing the data related to the outbreak of COVID-19 at Nanjing Lukou International Airport in 2021, the development trend of the epidemic situation was studied, and a reference for the prevention and control of the new crown epidemic was provided. Using the data from the official website of the Jiangsu Provincial Health Commission, draw an epidemic portrait of the number of newly diagnosed people every day. According to the official survey of confirmed patients, we will find the way of transmission of the epidemic. In the early stage of the new crown epidemic, insufficient airport control led to imported cases from abroad. Based on the normalization of epidemic prevention and control, this paper proposes epidemic prevention and control strategies for airports.

Keywords

COVID-19; Airport; Epidemic Prevention and Control; Strategy Research.

1. Preface

The outbreak of the Nanjing Lukou International Airport (hereinafter referred to as Lukou Airport) has spread in many provinces. This is the most severe challenge to China's epidemic prevention after the Wuhan epidemic. According to the COVID-19 prediction system developed by Lanzhou University, under the effective prevention and control measures of the government, the current round of the epidemic will be basically controlled around August 12, 2021, and the cumulative number of confirmed cases is about 425 (Figure 1). On June 25, 2021, Academician Zhong Nanshan said that in the global pandemic of the new crown epidemic, the delta mutant strain has become the main virus. According to its transmission characteristics, it is in the same space, unit, and building as the confirmed case. Those who have been in contact are collectively referred to as "close contacts", and the corresponding epidemic prevention and control strategies should also be adjusted accordingly [1]. At present, there are too few studies at home and abroad on the changing laws of the Lukou Airport epidemic and the behavior of patients. This paper fills in the data research of the new crown epidemic in Nanjing in July 2021 and the research gap of the relationship between human behavior and buildings based on the normalization of epidemic prevention and control.

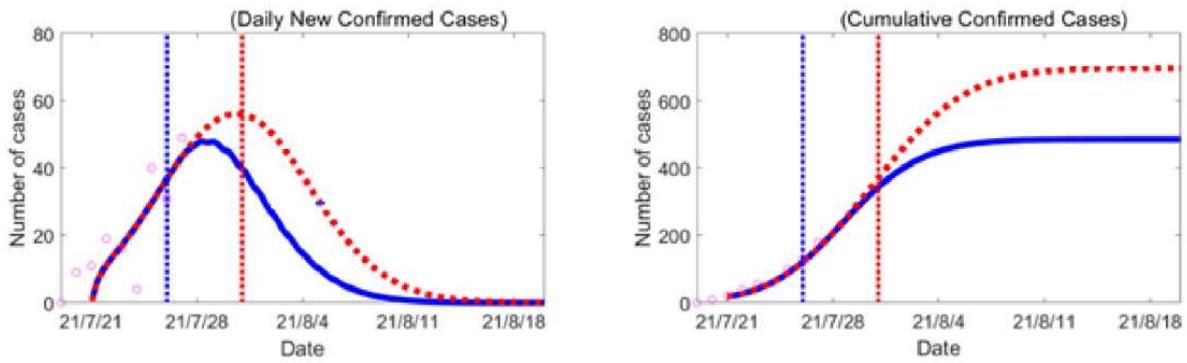


Figure 1. Lanzhou University's prediction of the outbreak of COVID-19 in Jiangsu Province on July 20

2. Airports Face the Current Crisis of the Covid-19

2.1 Basic Situation

On July 20, 2021, Lukou Airport screened 9 cases in the weekly routine nucleic acid test conducted by staff, of which 8 were ground cleaners and 1 was a cabin cleaner. On July 21, there were 4 new confirmed cases and 6 asymptomatic infections in Nanjing, all of whom were cabin cleaners and ground staff at Lukou Airport; on July 22, 12 new confirmed cases and 6 without symptoms were reported. Among those infected with symptoms, 16 were airport cleaning staff and 2 were family members of airport staff, indicating that the virus had spread from home, and the scale of the epidemic at Lukou Airport was further expanded, and the number of infected people continued to rise. Since then, under the timely prevention and control measures of the government, the spread of the virus has been effectively slowed down, and it leveled off in mid-August until it was cleared (Figure 2). According to the public statistics of the Jiangsu Provincial Health and Health Commission, from July 20, 2021 to August 20, 2021, a total of 235 cases of the new crown epidemic in Nanjing were diagnosed [2].

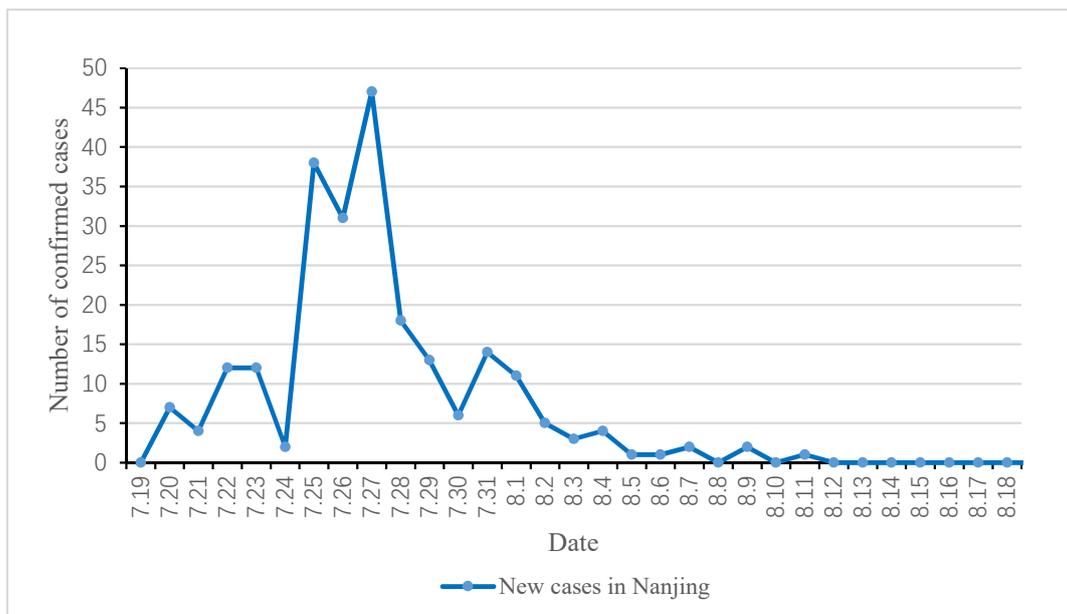


Figure 2. Daily statistics of new confirmed cases of COVID-19 in Nanjing

At the same time, in addition to the local and directly related cases in Nanjing, Liaoning, Sichuan, Beijing, Jiangsu and other places have successively reported cases of infection without a history of

living in Nanjing. On July 26, 2021, 3 new cases were added in Dalian City, Liaoning Province, and 3 people had traveled to Zhangjiajie, Hunan Province, and transited at Lukou Airport on the way; on July 27, 3 new cases were added in Chengdu City, Sichuan Province, and 3 people had Go to Zhangjiajie and other places to play; on the same day, there were also several confirmed cases with a history of living in Zhangjiajie in Beijing and Jiangsu [3]. The above cases show that the intersection of their trajectories points to Zhangjiajie, indicating that the epidemic has spread across provinces. So far, the Lukou Airport epidemic has formed a secondary transmission focus in Zhangjiajie.

As of July 28, 2021, the Lukou Airport epidemic has leaked to 7 provinces, and the number of infected people has reached 200 [4]. The epidemic follows the "point-line-diffusion" law of transmission. Lukou Airport is the beginning of the epidemic transmission chain, and then spreads to other cities along multiple routes. The cases outside the province are basically spread at Lukou Airport. on the route (Figure 3).

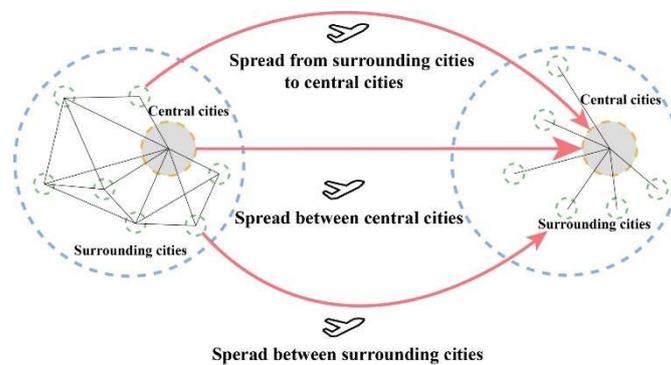


Figure 3. Paths of epidemic transmission between cities

2.2 Variant Strain

On July 27, 2021, Nanjing announced that the outbreak at Lukou Airport was the Delta strain[5]. Delta is a mutant strain of the new crown epidemic, which was discovered in India in October 2020 and then spread globally. On July 29, 2021, the WHO stated that the delta virus has spread to 132 countries and regions around the world, becoming the main epidemic strain of the global epidemic [6], (Figure 4). This strain has 3 key mutations. First, the transmission is stronger and the incubation period is shortened, which shortens the time from initial exposure, infection to clinical symptoms; second, the viral load is high. It is pointed out that the viral load of delta-confirmed cases is 1260 times that of the original strain [7], and the proportion of severe and critical cases is relatively higher than before; thirdly, the delta strain has "immune escape". The study found that, Of the three patients diagnosed after returning to China, two of them have been vaccinated, which shows that the delta strain partially avoids neutralizing antibodies and suppresses the immune response.

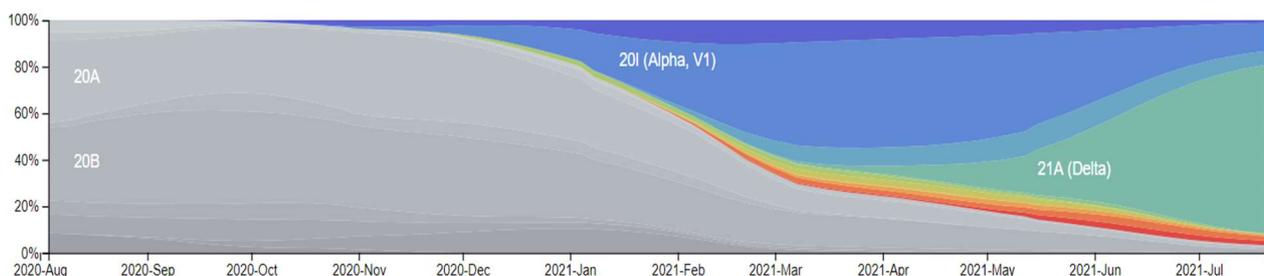


Figure 4. Global sampling of COVID-19 genome epidemiology

Note: Different colors represent different virus variants

Data source: nextstrain.org

2.3 The Cause of the Outbreak

On July 30, 2021, Nanjing reported that the case at Lukou Airport was consistent with the genetic sequence of an imported case of flight CA910 entering from Russia on July 10. Through the sorting out of China Civil Aviation Network, it was found that since the CA910 flight was issued a circuit breaker order in 2020, it has been executed for many times due to the detection of imported cases from abroad, and the cumulative number of confirmed passengers has exceeded 69.

Judging from the development of this epidemic, Lukou Airport has two major problems:

(1) Oversight of airport cleaning personnel

According to data from VariFlight, flight CA910 arrived at Lukou Airport at 9:50 on July 10, 2021, Beijing time. After the cleaning staff completed the cleaning and disinfection of the cabin, due to the non-standardized personal protection and killing, other cleaning staff were infected, and the epidemic spread among the cleaning staff. At the same time, the international flight cleaning staff and domestic flight cleaning staff at Lukou Airport mixed work, mixed use of cleaning tools, and shared rest areas. They did not achieve closed-loop management, which eventually caused cross-infection. Other staff at the airport were infected due to contact with cleaning staff and the polluted environment, and passengers who departed or transferred from Lukou Airport further spread the epidemic.

(2) Airport staff are negligent in control

At the beginning of the outbreak at Lukou Airport on July 20, the airport did not close the airport immediately and organize relevant personnel for centralized isolation on the spot. Some personnel still went home on the night of the 20th, and even risked being infected on the 21st. Risks go to work as usual, so that there are hidden dangers for the spread of the epidemic across provinces in the later period. At the same time, the study found that cleaning staff had symptoms of infection on July 13, but mistakenly thought it was a viral cold. The author believes that, in addition to the timely closure and isolation of personnel at the airport, the daily nucleic acid detection cycle of the staff once a week is too long, and the cases cannot be detected earlier, resulting in the potential spread of the epidemic for a long time.

3. The Importance of Epidemic Prevention at Airports under the Epidemic

Nanjing Lukou International Airport, the largest airport in Jiangsu Province, opened to traffic on July 1, 1997. It is a national large-scale hub airport, air cargo center and express distribution center, and one of the national regional transportation hubs. As of 2020, Lukou Airport has 135 domestic routes and 23 international routes, with 115 domestic and foreign destinations. With the development of globalization, in view of the efficiency and convenience of air transportation, the development of civil aviation transportation in my country is in full swing. As the main trunk airport in the country, the passenger throughput of Lukou Airport has been increasing year by year. The throughput reached 30.581 million (Figure 5).

However, the sudden new crown epidemic in 2020 has a huge impact on the country and even the world. This is another major public health emergency after SARS, which has caused a serious impact on civil aviation transportation. Taking Lukou Airport as an example, a large number of international and domestic routes have been suspended. In 2020, the passenger throughput has experienced a rare negative growth in the past 10 years, with a year-on-year growth rate of -34.9%, the largest decline in history. At present, the epidemic is still spreading wildly around the world. Before the new crown epidemic has not been effectively controlled, the airport, as the first line of defense for imported cases outside the country, has the characteristics of large radiation energy, wide range, and high concentration of people and logistics, which is the spread of the epidemic. In places with the highest risk, epidemic prevention and control work is undoubtedly the top priority.

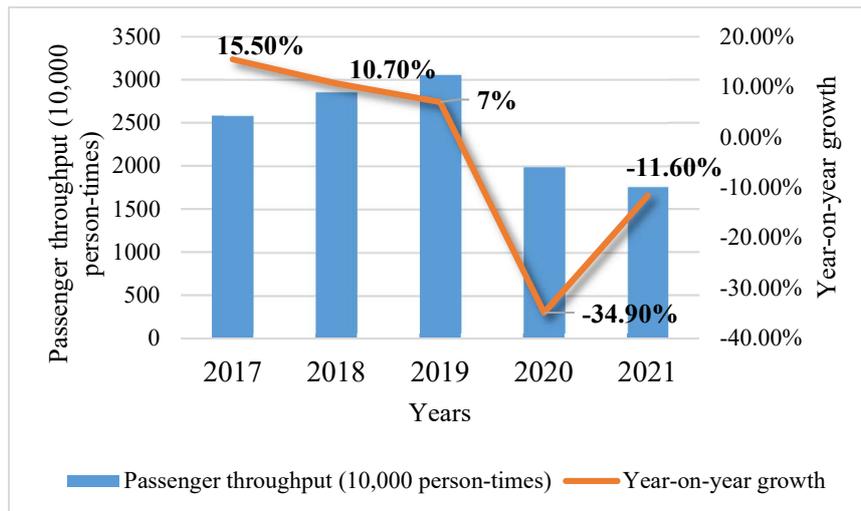


Figure 5. Statistics of passenger throughput of Nanjing Lukou International Airport in 2017-2021

4. Implementation Strategies for Airport Epidemic Prevention and Control from the Perspective of the New Crown

At present, my country has entered the stage of normalization of epidemic prevention and control. In the case of the continuous spread of the global epidemic, "foreign prevention of importation and domestic prevention of proliferation" is particularly critical. In view of the spread of the virus to many provinces due to the imported virus at Lukou Airport, the airport epidemic prevention and control strategy is proposed according to the different stages of the epidemic development.

4.1 Period of Outbreak

During the outbreak of the epidemic, the epidemic risk at the location of the airport where the departure flight was started was used as the evaluation standard, and the level of epidemic risk was classified for the inbound flight at the arrival airport, and different prevention and control measures were taken for passengers on flights with different risk levels. At the same time, the epidemic risk level of the airport is divided into three levels: low, medium and high. The risk level of the airport will be dynamically adjusted based on the actual local epidemic situation [8]. If the airport is in a high-risk area, the epidemic risk level of the airport is classified as high risk. At this time, due to the serious epidemic situation, the airport should be completely closed to prevent the spread of the virus. For example, in 2020, Wuhan Tianhe Airport was closed for 76 days due to epidemic prevention and control, which blocked the spread of the epidemic. According to statistics, during the epidemic, the number of international routes in China dropped sharply from 1,075 to 447, and the flight suspension rate was as high as 58.3%[9].

4.2 Effective Control Period of the Epidemic

After the epidemic is effectively controlled, the airport can be gradually reopened for use. As the only place for passengers to switch between air and ground transportation in airport transportation, the terminal building has risks such as large passenger flow, complicated personnel and long stay time, and it is very easy to become a huge hotbed of virus transmission. , so as to solve the problems of confusion and cross-infection in the terminal building. The behavior of passengers in the terminal building can be divided into departure flow line and arrival flow line. Compared with the arrival flow line, the optimization of departure flow line can more effectively reduce the risk of virus transmission in the cabin of passengers. The internal division of the terminal building can be divided into three areas: check-in, security check and waiting according to the passenger departure process "arrive at the terminal → check-in, check baggage → security check → wait → boarding → take off" (Figure 6).). In the check-in and security check areas, there is a lot of intensive contact between people, which

belongs to high-density areas and is the focus of this section. In the waiting area, the waiting space is relatively open, and the risk of virus transmission is small.

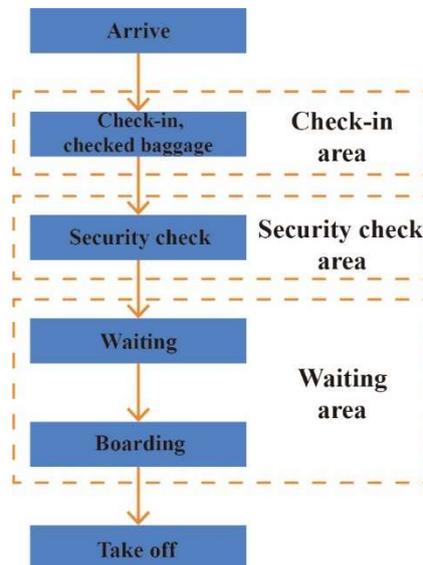


Figure 6. Flow chart of passengers departing from the terminal

(1) Check-in area optimization strategy

Due to the particularity of air transportation, passengers need to go through a tedious check-in and security check process before boarding, which will cause crowdedness and long queue times in these two areas, which will inevitably increase the possibility of virus transmission (Figure 7). In order to ensure a safe social distance between people, passengers should prefer contactless check-in, such as online check-in or the use of self-service check-in equipment. If passengers can only go through check-in procedures through manual counters, in order to avoid close contact between passengers on adjacent check-in lines, it is necessary to adjust the check-in method in the daily state and combine the two check-in lines into one group. At the window, ensure that each adjacent streamline can have a safe social distance of 2 meters (Figure 8). In addition, the counters are disinfected before and after each passenger's check-in procedures.

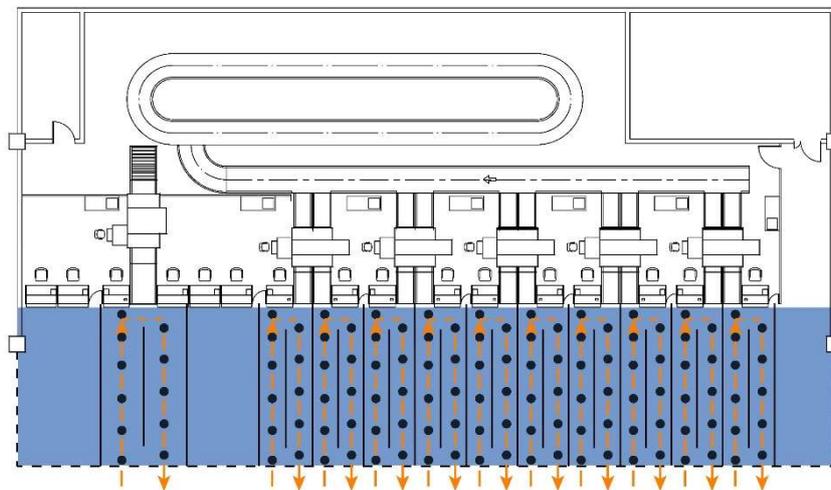


Figure 7. Check-in streamline in daily state

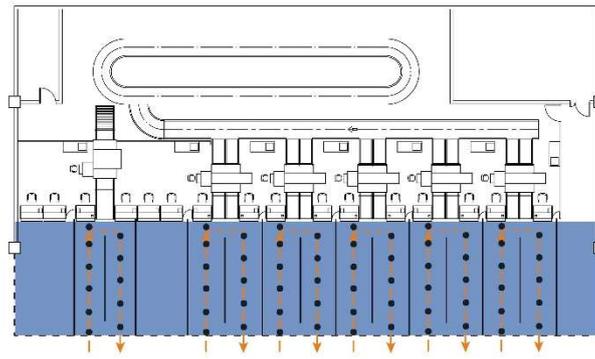


Figure 8. Check-in streamline under epidemic prevention and control

(2) Security check area optimization strategy

The security check area is a narrow place for passengers and staff to stay for a long time, and it is also a space where the virus can potentially hide, and it needs to be optimized and designed (Figure 9). In the queuing and waiting area of the security inspection area, in order to ensure the safe social distance between each adjacent streamline, the 1-meter distance in the daily state is adjusted to the 2-meter distance required for epidemic prevention and control (Figure 10). In addition, opening two security check channels with similar distances at the same time may lead to excessive gathering of passengers at the entrance of the security check channel, which no longer meets the needs of current epidemic prevention and control. Therefore, it is adjusted to share a security check flow line for two security check channels to reduce the risk of virus transmission [9]. And after each passenger's security check, security personnel need to disinfect the gloves and security check equipment to avoid cross-infection.

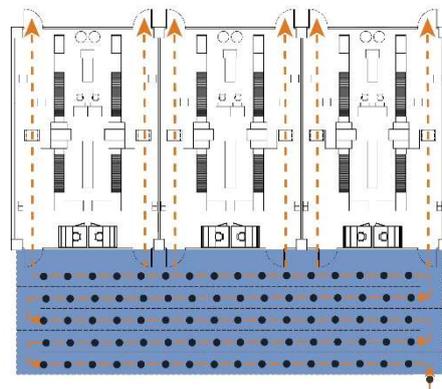


Figure 9. Security flow line in daily state

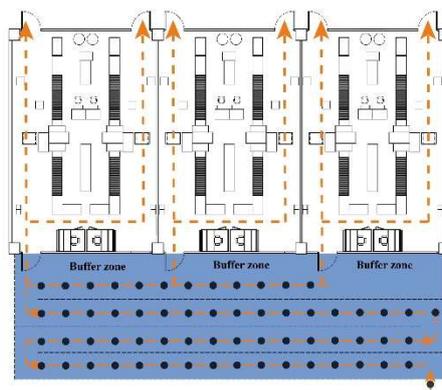


Figure 10. Security check flow under epidemic prevention and control

4.3 Post-epidemic Period

Due to the uncertainty of the current domestic epidemic and the lack of optimism in global epidemic prevention and control, it is particularly important for airports that have resumed operations to deal with the recurrence of the epidemic. First of all, normalized health testing spaces should be added in the departure and arrival halls of the airport, and body temperature and nucleic acid screening should be carried out for departing and arriving passengers, which can not only ensure the prevention and control of the epidemic inside the terminal, but also improve the immunity of the city[10]; Secondly, intelligence is the new direction for the future development of airport terminal prevention, such as self-service check-in equipment, automatic baggage sorting system and sensorless security check, etc. The use of intelligent equipment instead of manual labor can save time while also guaranteeing a safe social distance between passengers and reducing the risk of infection.

5. Conclusion

In the context of the global COVID-19 pandemic, airports have played a very important role in epidemic prevention and control as a transportation hub connecting cities and countries. From the epidemic in Hebei Province associated with Shijiazhuang Zhengding Airport in the winter of 2020, to the cross-provincial epidemic caused by Nanjing Lukou International Airport in the summer of 2021, the airport has a long way to go in the face of external defense imports.

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References

- [1] Regarding the Delta strain, Zhong Nanshan said..., [online] Available: https://m.thepaper.cn/baijiahao_13333263.
- [2] As of 24:00 on July 28, the latest situation of the COVID-19 in Jiangsu,[online] Available:http://wjw.jiangsu.gov.cn/art/2021/7/29/art_7290_9954475.html.
- [3] The Nanjing epidemic spreads for the second time in Zhangjiajie, experts: there is no end in sight for this round of epidemic, [online] Available: <https://baijiahao.baidu.com/s?id=1706525226861747719&wfr=spider&for=pc>.
- [4] This round of epidemic may have formed a dual center of transmission in Nanjing and Zhangjiajie, [online] Available: <https://m.gmw.cn/baijia/2021-07/29/1302442013.html>.
- [5] Nanjing held a press conference to report on the prevention and control of the COVID-19, [online] Available: <https://m.gmw.cn/baijia/2021-07/27/1302435492.html>.
- [6] WHO: Delta mutated virus has spread to 132 countries and territories, [online] Available: <https://www.chinanews.com/gj/2021/07-29/9531171.shtml>.
- [7] Li, B., Deng, A., Li, K. et al. Viral infection and transmission in a large, well-traced outbreak caused by the SARS-CoV-2 Delta variant. *Nat Commun*,vol.13,2022.
- [8] Yun Sheng,Xuedong Fang,Zili Feng.Influencing factors of civil airport epidemic prevention and control capability based on fuzzy mathematics evaluation.*China Science and Technology Information*,Vol.32,No. 21,pp.84-87,2020.
- [9] Xin Li,Hui Cheng, Jiaping Liu, Yuanchao Zhao. The concept and construction strategy of zoning epidemic control in the terminal building of hub airport.*Industrial Construction*,Vol.59,pp1-10,2022.
- [10] Haixiao Pan,Song Sun,Yaolu Shi. The resilience of transportation buildings under the normalization of the epidemic.*Contemporary Architecture*,Vol.1,No.10,pp30-32,2020.