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Optimization of Passenger Transport Organization for Effectively Alleviating the Spread of Respiratory Infectious Diseases in Underground Stations

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Abstract: The sweep of the COVID-19 pandemic has made people aware of the transmission patterns of respiratory infectious diseases, and effective prevention and control measures have become an important method to block the spread of the virus. Urban rail transit underground stations, as enclosed indoor spaces, how to effectively utilize passenger transportation organizations to block the spread of respiratory infectious diseases is conducive to the development of public health. As the backbone and pillar of urban public transportation, urban rail transit will become the core focus of urban epidemic prevention, control, and response due to its large volume and enclosed space. This article combines the impact of the epidemic on rail transit, lists various infectious diseases and their transmission routes in recent years, summarizes the challenges faced by the operation of Wenzhou Light Rail before and after the impact of the epidemic, and proposes corresponding countermeasures and suggestions for passenger transportation organization, train operation organization, and other aspects based on the current operating situation.

1. Introduction

The COVID-19 epidemic is a major public safety event with the fastest transmission speed, widest infection area, and greatest difficulty in prevention and control among the current infectious respiratory diseases. Since the outbreak of the COVID-19 pandemic in 2019, various regions have been strictly controlling the number and density of personnel in the space, and the operation of urban rail transit has been affected to varying degrees with changes in epidemic control. The COVID-19 pandemic, as one of the respiratory infectious diseases, reflects the contradiction between modern health events and the development of rail transit. Urban rail transit, as the main public transportation mode, is the main place for passenger flow and an important link in epidemic control for urban rail enterprises. For passenger transport organizations, passenger flow control is one of their key responsibilities, and it is also a barrier line for the safe operation of urban rail transit. [1-2]There are issues such as how to screen abnormal passengers, respond to extreme passenger flow changes, and ensure station operation safety. In this regard, this paper takes the operation of light rail in Wenzhou, one of the representatives of respiratory infectious diseases, as the pivot point, and relies on the epidemic prevention idea of "prevention screening response

disposal", combined with relevant data and quantitative indicators, analyzes and summarizes the existing challenges, points out the shortcomings of current measures, and provides practical and referential guidance for the double realization of accurate prevention and control and safe operationWireless sensor network (WSN) is a set of sensor nodes with sensor detecting, communication and event processing capabilities deployed in the monitoring area. These nodes form a multi-hop and self-organizing network system by wireless communication way [3]. It is put forward and studied by the US military for military needs. With the rapid development of wireless communication technology, micro computer technology, system on chip and low-power embedded device, the application field of wireless sensor network is wider and wider. Because of its wide coverage and self-organizing ability, wireless sensor network has made great changes in information sensing field by adopting the advantages of wireless communication, low energy consumption and high reliability [4].

2. Transmission patterns of respiratory infectious diseases

With the continuous development of urbanization and the continuous expansion of urban area, there has been an uncoordinated contradiction between human development and the ecological environment. A large number of infectious diseases are rampant in human daily life. In recent years, respiratory infectious diseases with wide transmission channels and fast transmission speed have been the most concentrated. Respiratory infectious diseases mainly refer to infectious diseases caused by the invasion of pathogens from respiratory infections such as the nose, throat, trachea, and bronchi of the human body. At present, common respiratory infectious diseases mainly include the following:

(1) H1N1 influenza is mainly transmitted through respiratory tract and contact, mainly through droplets such as sneezing and coughing. Prevention and response can be achieved by enhancing one's own immunity, washing hands frequently, and maintaining regular ventilation.

(2) Smallpox is mainly transmitted through respiratory tract, contact, and air. The virus can be isolated by avoiding direct contact with patients and their belongings.[5]

(3) Measles is mainly transmitted through respiratory droplets. Response can be achieved through vaccination, isolation observation, and other methods.

(4) The main transmission routes of the COVID-19 epidemic are respiratory droplets and close contact. In addition, it can also be transmitted through aerosols in confined spaces. You can prevent virus transmission by wearing masks, washing hands frequently, and disinfecting frequently. In summary, the effective ways to deal with respiratory infectious diseases mainly include wearing masks and blocking transmission; Open windows frequently to maintain circulation; Vaccination and prevention in advance. Both individuals and the environment should be taken into account to effectively block transmission in a timely manner.[6-8]

3. Changes in passenger flow of urban rail transit before and after the COVID-19 pandemic

Due to the impact of the epidemic, the overall operation of Wenzhou urban rail transit is at a low level. The following is the passenger flow situation of Wenzhou's s1 line during the epidemic period in 2020, which can be summarized as follows:

(1) During the outbreak of the epidemic - passenger flow showed a "cliff like" decline.

(2) Before and during holidays, there has been a significant decrease in the number of people returning home and participating in Spring Festival transportation.

(3) Resumption period - The passenger flow shows a "ladder like" upward trend. (Key section: rapid rebound, with a surge in passenger flow pressure; ordinary section: mainly concentrated towards early peak hours, rebounding day by day, in a decentralized agglomeration state.).

(4) The opening stage of the epidemic - the passenger flow showed a "peak like" surge, with an unprecedented large passenger flow situation, but overall it is still smaller than the passenger flow before the impact of the epidemic.[9]

4. New Trends in Lifestyle Changes and Travel Habits of the People in the Post-4 Epidemic Era

The outbreak of the COVID-19 epidemic has had a significant impact on urban traffic development and human travel habits. In the post pandemic era, in order to further block the spread of the virus, people's requirements for travel tools tend to be miniaturized, private, and flexible. Private cars, walking, and cycling have become the choices of more and more people; In terms of travel habits, wearing masks has gradually become a norm, and maintaining a one meter gap and not gathering or gathering has become a safety benchmark in people's minds.[10]

5. Challenges faced by urban rail transit operations under the impact of the epidemic

(1)Two extreme passenger flow scenarios

Using the peak period of the epidemic outbreak, due to policy guidance, it was forced to shut down, resulting in a sharp decrease in passenger flow.

During the period of epidemic relief, there has been a surge in passenger flow.

(2) Impact of other modes of transportation

Due to concerns about the epidemic, people tend to use walking, buses, and other means of transportation, which limits and hinders the passenger flow of urban rail transit to a certain extent.

(3)There are unknown security risks

If the inspection at the entrance is not done properly, it will lead to a huge safety and health accident in the confined space.

6. Countermeasure analysis

In order to further respond to the changes brought about by the impact of the epidemic and better coordinate the relationship between station operation, passenger travel, and safety prevention and control, the following improvements and requirements are proposed for passenger transportation organization, train operation organization, and station equipment.[11-12]

6.1 Passenger Transport Organization

(1) Develop emergency plans based on policy recommendations

The staff should implement it in a timely manner to maintain the virus transmission range as controllable as possible.

(2) Conduct safety examinations and establish employee systems

Eliminate the root cause within the company and prevent the spread of viruses among internal personnel.

(3) Strengthen passenger screening and regularly disinfect stations

Reduce the introduction and expansion of virus sources; Block the transmission of residual viruses in the original air.

(4) Broadcast reminders and increase publicity efforts

Guide and evacuate passengers in the station hall and platform, remind them to wear masks, maintain a safe distance, disperse their rides in an orderly manner, and prevent viruses from entering the station.

6.2 Train operation organization

(1) Improvement and optimization

Improve and optimize the storage and quality assurance of train operation diagrams at the station to ensure accurate train operation diagram information.

(2) Real time collection

Real time collection of passenger flow on existing routes, and collection of real-time changing data information based on passenger flow conditions.

3) Clarify responsibilities

When changes in passenger flow lead to changes in the train diagram, the responsibilities of each department and position under the new train diagram should be clarified in a timely manner to effectively identify safety hazards.

6.3 Station equipment

(1) Equipment operation

Reasonably adjust the work and plan of equipment maintenance to ensure the safe and stable operation of the equipment.

(2) Equipment Safety

Establish a quality assurance responsibility system, assess and evaluate equipment and technical personnel, and improve safety and responsibility awareness.

(3) Personnel Exclusion

Reassign personnel to avoid situations where excessive concentration of personnel near the equipment can lead to equipment malfunctions.In this experiment, the deviation of coordinate values is used as the main evaluation index of the positioning accuracy of the evaluation system. It needs to be explained that, in order to conveniently see the location and display results of the host computer, the display part has enlarged and translated the coordinate value (x, y) of the actual location result, and the coordinate value actually displayed is (3*x-50, 3*y-50) with unit of cm. The three-point localization experiment was carried out in 10 groups, and the record data were shown in Table 2. It can be concluded from the table, the estimated value of X axis coordinate system and the Y axis and the target actual value of X axis coordinates and the Y axis deviation was less than 2cm. After calculation, the actual maximum deviation distance between the target coordinate estimated by the system and the actual target coordinate is less than 2.3cm, which is only 2.05% deviation relative to the monitoring area of 120cm. It can be concluded that the target tracking system constructed based on wireless sensor network has good positioning accuracy.

7. Conclusion

The prevention and disposal of public health incidents will be a new and long-term topic for urban rail transit operation enterprises, and prevention and control measures will also be updated and changed in real-time with the spread of the virus and human cognition. Urban rail transit enterprises should always grasp the relationship between precision, safety, economy, and comfort, and abide by three principles: understanding the dynamics of the disease, strengthening investigation and prevention; Mastering prevention and control requirements and implementing deployment in real time; Focus on operational monitoring and optimize organizational strategy. On the basis of precise prevention and control and safe operation, improve passenger comfort, effectively achieve sustainable socio-economic development, and expand new dimensions of urban rail transit development.

References

[1] Wu Jinlong, Ding Xiaobing, Liu Zhigang. Research on Epidemic Prevention Strategies for Shanghai Rail Transit System - Against the Background of the Novel Coronavirus Pneumonia Epidemic [J]. Urban Transportation, 2020, 018 (003): 46-50

[2] Kan Changcheng, Ma Qiwei, Dang Anrong. Calculation and Optimization Suggestions for Commuting Passenger Flow in Public Transport System under the Epidemic: Taking Beijing as an Example [J]. Urban Transportation, 2020, 018 (003): 33-41, 70

[3] Liu Haiping, Xiao Yao. Strategies for Bus Traffic Operation Management in the Prevention and Control of Sudden Epidemic [J] Urban Transportation, 2020, 18 (3): 42-45, 92

[4] Li Jian. Abnormal Traffic Control and Resilient Traffic System Construction [J]. Urban Transportation, 2020, 18 (3): 9-10

[5] Yanhong Lan. Research on Capacity Evaluation and Plan of Urban Traffic Emergency System [D]. Beijing: Beijing Jiaotong University, 2008

[6] Luo J J. Study on the Aerodynamic Characteristics of Tunnel and Metro Station with PSD During High speed Train Passing Tunnel [J] International Journal of Signal Processing, Image Processing and Pattern Recognition, 2016, 9 (6): 379-392

[7] Zhang H, Zhu C, Liu M, et al. Mathematical modeling and sensitive analysis of the train induced unsteady airflow in subway tunnel [J] Journal of Wind Engineering&Industrial Aerodynamics, 2017, 171:67-78

[8] Wang Chunwang, Li Xiaofeng, Qin Xu, et al. Experimental Study on Wall Temperature Characteristics of Subway Tunnel [J]. HVAC, 2020, 050 (005): 95-101,10

[9] Gan Tian, Wang Wei, Zhao Yaohua, et al. Establishment and validation of a Fluent dynamic grid model for subway piston wind [J]. Architecture Science, 2011, (8): 75-81

[10] Lihui Wang, Xiping Wu, Wangli Hui, et al. The influence of subway piston wind on station environmental control speed field [J]. Journal of Underground Space and Engineering, 2007, 3 (1): 161-166

[11] Ma Jiangyan. Analysis of factors affecting the winter thermal environment of subway stations in northern China [J]. Journal of Railway Engineering, 2019, v.36; No.255 (12): 99-105

[12] Hu Wenbin. Frequency Conversion Technical Scheme for Ventilation in Subway Sections of Xi'an Screen Door System [J]. Architecture and Culture, 2019, 181 (04): 175-176