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The Application and Implication of Big Date Technology for COVID-19 Prevention and Control in China Based on the Whole Process Perspective

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ABSTRACT

After the outbreak of COVID-19, due to the limitations of traditional epidemic prevention methods, the Chinese government actively applied big data technology to pandemic prevention and control. This article takes the whole process perspective to summarize the application of big data technology for pandemic prevention and control in the emergency prevention stage and normalized prevention stage separately. The previous studies have explored the application of big data technology mainly focused on the early monitoring and early warning of epidemic but have not yet shed light on the perspective of full process. Second, this article identifies the main shortcomings of big data technology application in pandemic prevention and control and stresses the healthy development of big data technology is inseparable from effective supervision. The application and value of big data technology have brought new enlightenment to China's emergency management, including establishing a new big data service platform, improving "social listening", and building resilient smart cities with a digital emergency management system.

INTRODUCTION

The rapid spread of COVID-19, the wide range of its effects, and the extent of its hazards have brought unprecedented challenges to the prevention and control work in China. Traditional pandemic prevention means and methods have been difficult to play an efficient and effective role. In the face of the onslaught of COVID-19, the State Council issued the "Work Plan for the Prevention and Control of New Corona Virus Infected Pneumonia" on January 27, 2020, clearly stating that all regions should fully apply "big data + grid" and other means to do a good job in pandemic early warning, monitoring, screening, detection, and other work. [1] General Secretary Xi Jinping stressed at the 12th meeting of the Central Deep Reform Group that "we should encourage the use of big data, artificial intelligence, cloud computing, and other digital technologies to better play a supporting role in pandemic monitoring and analysis, virus

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tracing, prevention, control and treatment, and resource deployment." Relying on big data technology, innovative tools conducive to pandemic prevention and control with feasibility are emerging and being put into use. Modern information technologies such as mobile Internet, big data, cloud computing, and artificial intelligence connect geographically and systematically distributed resources and information to break down information barriers and data silos, making pandemic prevention and control more accurate and effective. [2]

THE APPLICATION VALUE OF BIG DATA IN THE EMERGENCY PANDEMIC PREVENTION STAGE

Emergency management is a complex adaptive system, and China's pandemic response needs to coordinate the participation of multiple entities to achieve a balanced whole process. [3] Big data technology helps pandemic prevention in the emergency prevention stage and gives full play to its intelligent advantages. Its application value is reflected in multiple aspects of fighting the pandemic, such as monitoring, early warning, screening, detection, treatment, etc.

Big Data Supports Situation Prediction and Early Warning

With 1.6 billion cell phone users in China, big data in telecommunications is one of the crucial data sources to provide a basis for judging the development trend of the pandemic, especially the "inflection point". During the anti-pandemic period, the Ministry of Industry and Information Technology (MIIT) submitted daily situation analysis and early warning information on floating personnel to the central government and relevant localities. At the early stage of the outbreak of COVID-19, combined with the big data analysis of the outflow of people in Wuhan and Hubei Province, the MIIT issued timely warnings on the pandemic situation to relevant regions, providing real-time, accurate, and comprehensive decision-making support for pandemic prevention and control. [4]

Big Data Helps with Virus Tracing and Personnel Identification

Fully containing the spread of the pandemic is the top priority in the fight against the pandemic. Big data analysis technology focuses on key provinces and regions, key time points, combing the life trajectory of infected persons, establishing individual relationship maps, and tracking the contact history of people. Technical means accurately locate the source of infection and close contact with people, support the thorough and effective deployment of pandemic prevention and control, and provide extremely valuable information for "early detection, early isolation, and early treatment".

Big Data Powers Smart Diagnostics and Drug Development

It is known through medical reports that the new coronavirus mainly attacks the human lungs. Clinicians can easily synthesize 3D images of the lungs by using big data and artificial intelligence technology to replace CT layered scans and restore the infection in patients' lungs. Besides, the artificial intelligence drug research and development big data platform of the School of Pharmacy of Tsinghua University has collected experimental information of more than 900 small molecules involved in previous coronavirus research, and using the big data platform it is possible to accelerate drug screening and vaccine development.

Big Data Supports Material Scheduling and Production Demand Docking

During the pandemic prevention period, medical supplies were once in serious shortage, and social anxiety also deepened. The relevant big data companies have launched online query platforms which can quickly screen out qualified suppliers of protective materials, to facilitate the online purchase of masks, protective clothing, goggles, and other materials. Upstream suppliers can also be docked on the platform to directly provide raw materials to the protective materials production enterprises, to achieve a seamless connection between upstream, midstream, and downstream of the supply chain. In addition, the China Academy of Information and Communications Technology has developed a security and dispatch platform for key medical materials, which improves the effectiveness and timeliness of security and scheduling and minimizes the shortage of medical protective supplies in pandemic areas.

Big Data Helps Resume Work and Production Orderly

Using big data on electricity, it is possible to grasp the resumption status of regional enterprises and, based on electricity usage, to get a more macroscopic view of regional resumption trends. Moreover, a big data technology company has launched an intelligent park pandemic prevention solution, which applies to densely populated buildings and production parks. It supports the need for temperature sensing monitoring at the initial stage of resumption of work and the need for overall pandemic prevention and safety management in the middle and later stages. To be more specific, it can automatically identify the wearing of masks, detect human body temperature with infrared, intelligently capture fever personnel, and monitor potential pandemics at all times. This has played an essential role in enhancing the pandemic monitoring and early warning capability of the factory park and has built a solid pandemic prevention safety defense line for the resumption of production.

THE POSITIVE ROLE OF BIG DATA IN THE NORMALIZED PANDEMIC PREVENTION STAGE

As the growth rate of the number of COVID-19 patients across the country has slowed down significantly, the prevention and control of the pandemic have entered into the normalized stage. The resumption of work and production in enterprises is gradually taking place, schools are steadily resuming classes, and people's daily lives are gradually getting back on track.

The Necessity of Electronic Health Code

The human mind can slacken, but the data does not. The electronic health code is a product of the extraordinary anti-pandemic period. An embarrassing fact faced by normalized pandemic prevention is that the public, including the pandemic prevention and security personnel, have become lax in their thinking and complacent to varying degrees. Many people are optimistic that the pandemic has been fading away and have begun to relax their protection. The security personnel in some public places, due to the long and intense work, coupled with the single repetition of quarantine content, led to a weak mind and loose attitude, which undoubtedly planted deeply hidden dangers for the normalization of prevention and control work.

Due to practical needs such as the resumption of work and school, all regions are exploring upgrading the health code iteration to a wider application, as a critical auxiliary means of normalized pandemic prevention. Health codes are generally developed by the local government and Internet technology companies and operate on the principle of providing relevant information through individual authorization, which is ultimately generated by the back-end data system through analysis. As a personal electronic health credential, the public can show the health code to enter and exit various public and business premises. Furthermore, Employers have easier access to personal travel and health information in the form of regular health code checks, which simplifies the prevention process and ensures accurate information.

The Prevention Measures for Overseas Imports

With the continued spread of COVID-19 internationally, strict prevention of overseas imports has become another heavy challenge for normalized pandemic prevention. To do a good job in pandemic prevention and control for foreigners, a tight pandemic prevention net has been built for urban safety through the establishment of visual big data integration.

Take the Xiulong residential area of Shanghai as an example, where the foreign people pandemic prevention control system was first adopted. The system realizes the visualization, refinement, and dynamic control of all people in the district in the form of a community map and building list. In the early stage, all residents' information, nationality, whether in Shanghai or back to Shanghai, location, and route before returning to Shanghai and other series of data were entered into the intelligent platform

through full coverage mapping of the community, with the building as the unit. Later, full coverage and full process management were achieved through real-time data updates.

In addition, the pandemic prevention and control system for foreigners can share and link real-time information with the pandemic prevention command platform of the urban transportation center. The pandemic prevention and control electronic map of the urban transportation platform is marked with real-time updated data of incoming persons, home-isolated persons, community entrances and exits, crowded places, hotels, and other areas. Community staff can obtain accurate information data on the block through quick screening to understand the situation of foreigners returning to Shanghai and implement pandemic prevention and control measures in a timely and accurate manner.[5]

PROBLEMS AND SHORTCOMINGS OF BIG DATA TECHNOLOGY APPLICATION FOR PANDEMIC PREVENTION AND CONTROL

In terms of pandemic prevention and control work, the application of big data technology and effective regulation are accelerating the development of each other. How to grasp the balance between data protection and data openness, a topic that received public attention and hot discussion during the pandemic, is also an issue that must be thought about when using big data well.

The Data Security System is not Perfect

The starting point for effective pandemic prevention and control with the assistance of citizens' personal information is to protect the public interests and serve social governance, but there must be strict norms and boundaries to constrain the use of data. For example, the adoption of the personal electronic health code should first comply with the legal provisions, but also follow the principle of public permission. The health code information platform needs to be built according to the relevant national information system security level protection standards, to effectively protect the privacy of citizens and information security. On February 9, 2020, the Cyberspace Administration of China(CAC) issued the "Notice on Protecting Personal Information and Using Big Data to Support Pandemic Prevention and Control", which encourages the adoption of big data to support pandemic prevention and control while specifying the conditions for the collection, use and disclosure of personal information, and particularly emphasized the importance of data privacy protection and personal information security protection to prevent information from being stolen and leaked.

Relevant Laws and Regulations are not Complete

The collection of personal data should be done by the law, to protect the original data available but not visible, not to change the ownership and storage location of the data, and only gain access to analysis results that do not contain sensitive data. To put things into perspective, big data is not only related to commercial interests but also

related to national political and social issues. In the system of big data for pandemic prevention and control, it is essential to define access rights and process auditing, use various security measures to ensure the safety of data use, consider social governance and data security, and make data available and controllable. Scholars have proposed that in China's "Emergency Response Law", it is necessary to add relevant provisions on the application of big data technology and data privacy to guide the desensitization application of citizens' private data involved in Level I and Level II emergencies in the future and provide legal support for big data interconnection under emergency conditions at the institutional level. [6]

IMPLICATIONS OF BIG DATA TECHNOLOGY APPLICATION FOR CHINA'S COVID-19 PREVENTION AND CONTROL

During the prevention and control work of COVID-19, the application value of big data technology in various fields has been highlighted, which will objectively accelerate the digital transformation from the central to the grass-roots level and add fuel for the modernization of social governance. On the other hand, it also brings some inspiration to the development of emergency management in China.

Take the Pandemic Prevention and Control as an Opportunity to Establish a New Big Data Service System for the Whole Society

During pandemic prevention and control, the government effectively used mobile phones and network data sources to support the enterprises' construction of data repositories by purchasing services. Some enterprises that can provide data services have used this data integration to conduct in-depth research and development and established a new data information platform for social public services and commercial services. What's more, governments at all levels can reform the traditional data collection methods, and re-establish a real big data system centered on the Internet and information technology and based on user data sources. The government's information platform and data platform will be integrated, and the service only for the government will be shifted to the service for the whole society, to deal with various unexpected crises that may occur in the future.

Do a Good Job of "Social Listening" Based on the Big Data Platform to Improve the Ability to Respond to Public Opinions

In the early stage of COVID-19, the lack of timely response to online public opinion by relevant departments led to public panic to a certain extent, and the government's credibility subsequently declined. In the process of fighting against the pandemic, the quality of notification of the pandemic situation has been continuously improved, and the open and shared data has been developed into various application products by Internet companies, such as visualized pandemic maps and nearby

diagnostic sites. After being made public, these data have been developed and designed for mobile applications that everyone could download, helping to eliminate panic, dispel rumors and prevent the pandemic accurately. It has been proven that timely and effective public opinion response is necessary for emergency management. The big data platform plays the role of public opinion collection, public opinion monitoring, and risk investigation, and relies on it to do a good job of "social listening", which helps to grasp the changes in public sentiments, attitudes, and risk perceptions in an in-depth manner, and provides support for effective public-oriented risk communication.

Construct a Digital Emergency Management System and Enhance the Emergency Response Capability of the Smart City

A smart city should not only have smart transportation, and smart security but also have immunity and disaster resilience. It should take the big data-based disease prevention and control system as a fundamental starting point for building smart cities. A comprehensive emergency management system includes emergency decision-making systems, such as a big data decision-making system for pandemic prevention materials and a big data decision-making system for the education sector.[7] It breaks the information barriers of each link and department, integrates multidimensional data from health, communication, transportation, public security, population, meteorology, etc., establishes a real big data platform that is interconnected under various emergency conditions, enhances the emergency response capability and fully exploits the application potential of the smart city.

As COVID-19 spreads around the world, Austria, Israel, and other countries have also applied big data technology to the forefront of pandemic prevention and control work. Based on the urgent demands of pandemic prevention, big data technology has been allowed to "show its strength", which has greatly advanced the practical application of big data in emergency management and demonstrated its irreplaceable value in social risk management.

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