



# Research on Epidemic Predictive Modeling, Data Fusion and Effective Prevention and Control Strategies by China's Digital Government Take Guangzhou as an Example

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**Abstract.** In recent years, China has actively advocated the construction of digital government. With the continuous progress of the times, China's digital government has the characteristics of wide coverage and strong integrity. At the same time, digital government has played a great role in the prevention and control of the COVID-19 epidemic. During the outbreak, it is crucial to analyze the risk of the epidemic and evaluate the effectiveness and timeliness of prevention and control strategies based on mathematical models and combining a small amount of real-time and updated multi-source data. Based on the previous researches and combined with the concept of digital government, the study intends to analyze the existing problems of epidemic prevention and control policies in Guangzhou by applying mathematical modeling and in the meantime, to gradually establish a model in line with the prevention and control strategies. Studies how Guangzhou can use digital technology to ensure the safety of the masses, better grasp the development track of the epidemic, launch a strong implementation plan in the unpredictable trend of the crisis and how to minimize the losses of the crisis.

**Keywords:** digital government · Mathematical Modelling · Epidemic prevention and control

## 1 Introduction

With the rapid development of emerging technologies such as big data, cloud computing, blockchain, artificial intelligence and the Internet of things, an idea of “smart governance” that superimposes technology orientation and government governance came into being, and the smart society has come [1]. Digital government has become the leader in promoting the construction of smart city. The construction of a new smart city is a centralized carrier that reflects the modernization of the national governance system and governance capacity. Promoting a new smart city is inseparable from the support of digital government [5]. At present, according to this situation, China has rapidly established a number of big data management bureaus within the national government. Since China began to implement the construction of “smart city”, the number of “smart city” pilot projects announced by the Ministry of housing and urban rural development has

gradually increased. The digital government structure of Guangdong Province can be divided into “Five Scenes and Three Demands” and integrates the latest information technologies, communication technology and data technology. Based on the development of artificial intelligence, Internet of things, 5G, key chips and other industries, Guangdong Province improves the basic support of digital government cloud platform and perception system, promotes the integrated development of BIM (Building Information Modeling) and CIM (City Information Modeling), and improves the network infrastructure Software Definition Network (SDN) Application of Network Function Virtualization (NFV) and other technologies. The government extranet SRv6 tunnel technology realizes fast connection. It helps the digital government and improves the service management ability of the digital government by adopting SDN + SRv6 policy, IFIT streaming technology, IPv6 + automation technology, AI algorithm and other latest technologies. China’s covid-19 pneumonia is a severe public health emergency which has a wide range of infection and is difficult to control. As a first-class “smart city” construction planning big city, Guangzhou focuses on transportation, medical treatment, education and other fields related to people’s livelihood. The municipal government of covid-19 has implemented covid-19’s decision and deployment in the prevention and control of the new crown pneumonia. The Guangzhou government has made decisions and plans with the “digital government” as the core, and helped to control the epidemic situation with the help of “digital”.

## 2 Evaluation Model of Epidemic Prevention and Control Policies in Guangdong

### 2.1 Evaluation Model of Epidemic Prevention and Control Policies

In the face of the epidemic, the severity of the epidemic is different in each city of Guangdong Province. The paper will comprehensively take five factors into consideration: the number of cities where the epidemic has occurred (A), the degree of population aggregation (D), the number of infected people (I), the economic level (E), and the prevention and control effect (R), to analyze the epidemic severity and prevention and control effectiveness of each city in Guangdong Province by applying the entropy weight method.

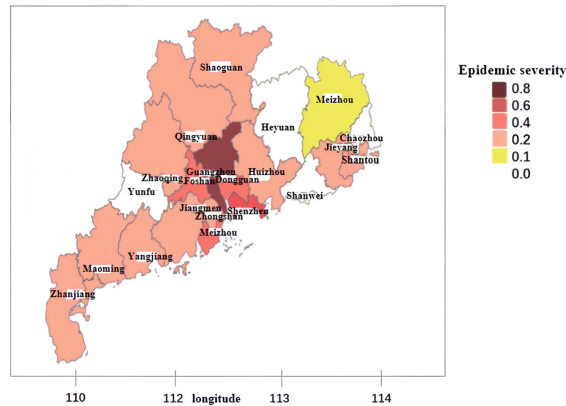
In the big model, indicators can be divided into positive indicators A and D and negative indicators I, E and R. Positive indicators mean that the bigger the indicator is, the more ineffective epidemic prevention and control is; The less negative indicators, the more ineffective epidemic prevention and control. The positive and negative indicators will be standardized as follows.

The positive indicators A and D are standardized as follows:

$$x_{ij} = \frac{C_{ij}}{\max_j \{C_{ij}\}} \quad j = 1, 2$$

The negative indicators I, E and R are standardized as follows:

$$x_{ij} = \frac{\min_j \{C_{ij}\}}{C_{ij}} \quad j = 3, 4, 5$$



**Fig. 1.** Schematic diagram of epidemic severity in Guangdong

After being standardized, the bigger the specific indicators  $j$  and  $x_{ij}$  are, the more ineffective the epidemic prevention and control in the city is.

## 2.2 Display of Modelling Results

Based on the data modeling analysis, the epidemic research degree of Guangdong province in 2021 are as follows: Guangzhou 0.8, Shenzhen 0.6, Foshan, Dongguan, Zhuhai 0.4, Shaoquan and other 11 cities 0.2, Meizhou 0.1, Heyuan, Shanwei, Yunfu 0, etc.

It can be seen from Fig. 1 that among all cities in Guangdong Province in 2021, the effect of prevention and control policies in Guangzhou and Shenzhen is relatively unsatisfactory. Despite the external environment, there are many problems in the prevention and control policies in Guangzhou according to the city’s scale, economic development level and population concentration. Therefore, this paper analyzes the new measures of epidemic prevention and control in Guangzhou by combining the results of data modeling and the concept of digital government.

## 3 The Role of Digital Government in the Prevention and Control of COVID-19

Under the era of Internet, it’s inevitable to respond and manage crises by applying big-data technology to enhance the effective prevention and control of the epidemic. Digitization can quantify all elements leading to crises and objectively show how they happen. Since Covid-19 is fast and widely infectious, as an important subject to manage the crisis, the government is supposed to respond and tackle this emergency with greater prevention and control capacity.

During this epidemic, digitization has been fully penetrated Guangzhou’s prevention and control. From the perspective of data transmission, the spread of corona virus is also the spread of information. According to Robert Heath, the crisis management is

composed of four phases: Reduction, Readiness, Response, and Recovery, which forms a dynamic process of pre-control, middle-control, post-control. Through his epidemic, Guangzhou government soon realized the crisis forewarning, crisis resolution and care-taking after crisis are essential aspects of resolving crisis [6]. In response to the crisis in different stages, the data online and resources offline during the epidemic must be seamlessly integrated, and a mechanism including an epidemic prevention preparation, emergency response, and recovery after epidemic must be established.

### **3.1 Epidemic Prevention Preparation Crisis Forewarning and Monitoring Mechanism**

As the main body of crisis management, the prevention measures of Guangzhou government have become more scientific in the support of big-data technology. Since the corona virus is fast and widely infectious, it's the key to prevent and control the pandemic efficiently to obtain data information fast and comprehensively. Before the epidemic, Guangzhou government applied the big data to forewarn the public, thereby avoiding the wide range of diffusion of the virus. On the tissue level, the blind sides had been prevented effectively with top-level design done, the digital linkage working mechanism established and the division of work of different departments before the epidemic prevention clarified. In September 2016, Guangzhou government has launched an urban digital governance project called "Four Standards and Four Actual". This project prepared the above elements into standardized describing characters, breaking the information barriers between each other. In the meantime, the project divided the entire Guangzhou into a total of 19,500 grids of unified standard foundation that were equipped with doctors, police, and grid helpers to visit, troubleshoot, and forewarn the epidemic, etc. [7]. In the meantime, big data has also improved the capacity of the Guangzhou government to deal with crisis, in which locations data provided the population flow. The government organized the three operators of China Mobile, China Unicom and China Telecom, together with various Applications with positioning systems to accurately predict the trends that the epidemic spread [4]. Before the emergency, Guangzhou government established digital emergency plans to identify and monitor crisis by using advanced data statistics and monitoring equipment, which gave full play to the sensitive digital system to minimize the crisis losses.

### **3.2 Emergency Response: Releasing Information and Expressing Expansion**

During this public health emergency, it's particularly important for Guangzhou government to figure out how to establish a public health crisis management mechanism timely when the epidemic occur and bring into efficiency of decision-making for emergency with limited data and information. When the epidemic spread to Guangzhou, being highly aware of tracking the epidemic and as the first dominant force, the government rapidly established a "big data + network" as a technical platform, in which information was collected and integrated, and strengthen information sharing of data systems in various fields to ensure collective precaution and treatment [2]. On May 21, 2021, after one confirmed case infected by corona virus in Liwan District, the district carried out data management work with the Guangzhou Administration Services and Data Authority.

Based on the data sources from the traveler's registration code system and the Nucleic Acid Testing (NAT) system, residents can make and take their appointment for NAT through the "Save Your Trouble in Guangdong" app, so that the nearby residents could be arranged for NAT efficiently. In the meantime, all close contacts were screened rapidly and over 100 million effective data were acquired with big-data network and the public security, public health, disease precaution and education systems united. When the public health emergency occurred, the digital monitoring immediately released an early warning and reduced the range of virus was spread. Moreover, supplies were accurately delivered to the quarantine areas by applying Bei Dou Navigation Satellite System to position vehicles and supplies, effectively preventing the epidemic from spreading and deteriorating.

### **3.3 Recovering After the Epidemic: Reducing Expending and Preventing and Controlling Efficiently**

After the outbreak of the epidemic, the Guangzhou government showed its great cognitive capacity with bigdata to improve the efficiency of the governance after the crisis, and quickly equipped with professional and technical personnel to operate and control. The Guangzhou CDC had launched a vaccine appointment system, which opened to 300,000 users' access to an appointment platform. Based on the system, all communities had been distributed vaccines and got vaccinated efficiently and in order, which greatly saved the costs of artificial statistics. The SARS in 2003, data statistics and data analysis technology applied during SARS in 2003 were relatively behindhand, because they were mainly controlled by Typical Pneumonia Command to jointly collect the infectious disease report cards of the infectious patients and suspected patients, which then would be typed-in and transmitted. In the end, the cards would be filled in and stamped with official seal by the Health Bureau. To verify the authenticity of the data, repeatedly in-depth on-site comparison was required, consuming great efforts. Digitization has achieved a more significant prevention and treatment than previous with less human and material resources, which prompted the government to make a limited resource more scientifically into the subsequent prevention and control. Guangzhou also created an online mask appointment mode and "Yellow Code" system. The personnel with yellow code were labeled and tracked by epidemic prevention, using digital health code identification technology has effectively helped with the resumption of work, school, and production after the epidemic (Fig. 2).

## **4 Effective Coordination and Implementation Plan for the Epidemic Prevention and Control Policies of In**

Policy coordination refers to the integration research of two or more policies, which is a coordination in policy development in different departments to achieve a common goal.

During the epidemic prevention and control, the relevant policies promulgated by Guangzhou were fully implemented according to CPC Central Community and Guangdong. To ensure the stable operation of various works in the prevention and control of the epidemic, improve the city governance system and governance ability. A variety of factors such as related social environments are analyzed to develop and promulgate.

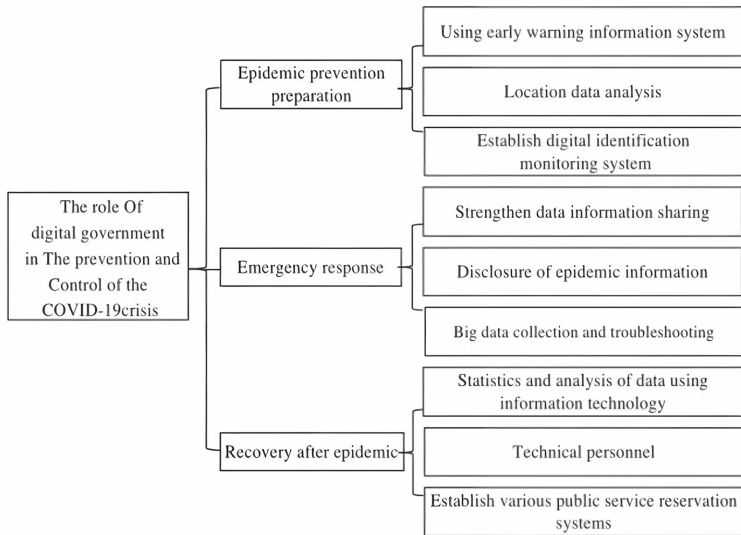


Fig. 2. Digital Epidemic Precaution System

#### 4.1 Effective Coordination of Policies

Due to the wide range of related documents, the general adoption of the following coordination methods in Guangzhou is generally related to a few departments. 1. Coordination within the policies: The study found that the documents of the epidemic prevention and control phase promulgated by Guangzhou City are highly consistent, and each document is designed to achieve economic and social goals with great efforts in the event of epidemic prevention and control. 2. Internal coordination: The relevant documents promulgated by the Guangzhou government reach longitudinal coordination and horizontal coordination in the internal coordination of the government.

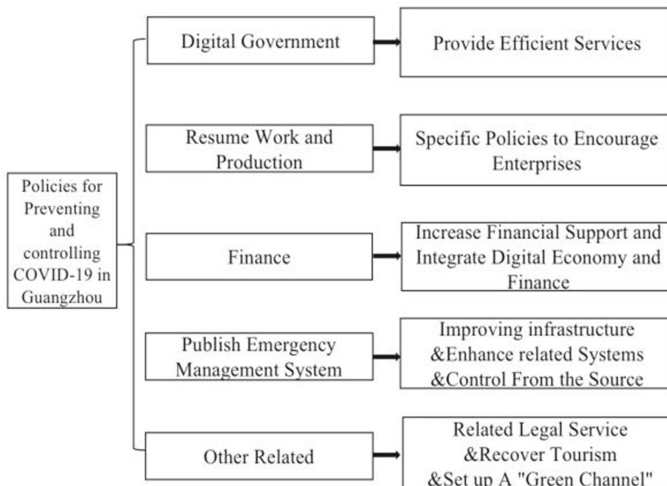
- 1) The relevant policies promulgated are implemented according to CPC Central Committee and Guangzhou Province. To form a situation in which the relevant policies of the central government are taken as the general policies, the relevant policies of Guangdong Province are taken as the basic policies, the specific policies are formulated by Guangzhou government according to the opinions of higher departments, and the policy documents are implemented by its functional departments, which effectively achieves vertical coordination within the government.
- 2) When implementing relevant policies, the functional departments subordinate to Guangzhou government will actively share data centering on the implementation of policies of superior departments and coordinate the overall situation and achieve horizontal coordination through comprehensive balance among all departments.
- 3) External coordination: First, Guangzhou government will actively coordinate with the social environment when formulating and promulgating relevant policies. The overall requirements of the document focus on the previous epidemic prevention and control, economic and social development, and livelihood protection, and give

preference to the medical environment, economic environment, and other important aspects. Second, actively coordinate with social organizations. For example, relevant policies will increase subsidies to social organizations such as trade enterprises and listed companies, to ensure the market supply.

### 4.2 The Implementation Plan for the Prevention and Control in Guangzhou

The relevant epidemic prevention and control policies issued by Guangzhou government cover a wide range of fields, including economy, politics, culture, agriculture, industry, commerce, medical insurance, and other industries, and are associated with more than 40 functional departments of the government. Therefore, effective implementation plan plays a great role in promoting the policy. In this paper, the relevant policies on epidemic prevention and control issued by Guangzhou government are mainly classified as: digital government, resumption of work and production, finance, public health and other five aspects (Fig. 3).

First, in order to adapt to the development of today's era, the Guangzhou Municipal People's government has also actively integrated into the digital government team in response to epidemic prevention and control events. In terms of digital government, Guangzhou aims to optimize government services, deepen the specific measures of government service platform processing, promote data sharing between horizontal and vertical departments on the government service platform, gradually promote online approval of window business, open government work through multiple channels, and improve policy awareness. In addition, Guangzhou also assisted in intelligent epidemic prevention through scientific and technological forces, developed new products and provided new services for the epidemic, continuously promoted technology companies to launch new technical equipment such as driverless automatic vehicles, and epidemic monitoring systems and non-contact thermometers to help combat the epidemic.



**Fig. 3.** Implementation Plan of Epidemic Prevention and Control in Guangzhou

Second, timely resumption of work and production is one of the important measures to effectively ensure economic and social development in the epidemic. In order to ensure the smooth operation of enterprises under the epidemic, the Guangzhou municipal government has put forward various policies to support enterprises. For example, reduce the economic pressure by reducing taxes, reducing enterprise handling fees, providing preferential interest rate loans and providing special loans. In addition, the government also actively provides relevant measures to establish express services for enterprises by unblocking the supply chain, solving employment problems and enterprise operation problems. At the same time, the Guangzhou municipal government also actively advocated the relevant to join the anti epidemic team and called on enterprises to bear social responsibility. Responding positively to the call, relevant enterprises in Guangzhou donated masks, protective clothing, goggles and other epidemic prevention materials by sending volunteers.

Third, in terms of finance, Guangzhou accelerates the integration of financial means through digital technology, takes “e-finance, digital finance and smart finance” as the development strategy, and is committed to promoting the innovative development of digital economy and finance. We will increase financial support and strengthen the standardized use of preferential policies for national special loans. During the pandemic, Guangzhou established a risk compensation mechanism for Pratt & Whitney loans and innovated the first national digital financial regulatory pilot area, set up the first digital finance association in China and digital financial comanagement center to promote the smooth operation of the financial system under the epidemic.

Fourth, Public emergency management system: public health events have the characteristics of sudden, urgency, responsibility and so on [3]. Under the influence of the epidemic, the response ability of public health is very important. Since the successful adoption of the SARS public health crisis in Guangzhou, the process of public emergency management system has been opened. In this regard, the Guangzhou Municipal People’s government has accelerated the construction of medical facilities and improved the system of disease prevention through request. It is required to control major public health risks from the source and form an efficient modern emergency system. Up to now, the emergency management system gradually established in Guangzhou is successfully responding to all kinds of public health events. At the same time, Guangzhou is actively promulgating all kinds of policies to continuously improve its ability to respond to public emergencies.

Fifth, in addition to the above aspects, Guangzhou has also actively implemented other livelihood policies, such as strengthening legal services, establishing an emergency public legal service mechanism, actively carrying out recovery measures for cultural tourism, attaching great importance to the foreign trade industry, increasing support for foreign trade enterprises, and reducing their business risks. Moreover, Guangzhou has also set up green channels of all kinds to make it convenient for the masses and social organizations to deal with their businesses. The unified coordination of various policies and the implementation of the plans adapting to the epidemic in Guangzhou have laid a solid foundation for works of all kinds in Guangzhou to go on wheels under the epidemic.



## 5 Conclusion

This paper analyzes the effective epidemic prevention and control strategies under the background of China's digital government implementation. First of all, we will discuss the role of digital government in epidemic prevention and control. Secondly, carry out the evaluation of epidemic prevention and control policies in Guangdong Province, and determine that Guangzhou has the lowest epidemic prevention and control policy efficiency among the 21 cities in Guangdong Province. In this environment, this paper combines and analyzes the strategy of epidemic prevention and control in Guangzhou and the characteristics of digital government. Scientific and technological technology, information technology, artificial intelligence, big data, etc. will be used in Guangzhou's epidemic prevention and control to clearly judge the risks and coping strategies of the epidemic. This paper recommends internal and external coordination of policies, that is, to formulate and implement effective prevention and control policies, more communication among policy decision makers, and assistance and mutual trust and encouragement between superiors and subordinate departments. In addition, the unified coordination and implementation of various policies and the implementation plan to adapt to the epidemic situation in Guangzhou have laid a good foundation for the smooth development of various work in Guangzhou under the epidemic.

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