How Does Big Data Play A Role in COVID-19 Crisis Response Management?

-- Experience from China

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Abstract

At the end of 2019 to the beginning of 2020, the new virus COVID-19 broke out, and the virus spread at an alarming rate. Political, economic, and livelihood exchanges between China and other countries and regions have been severely affected by the epidemic and are facing unprecedented challenges. In this process, the new generation of information technologies such as big data and cloud computing have become the pioneers of the digital "war epidemic", deeply integrated with the governance during the epidemic prevention and control period, and they have all made strategic contributions to the Chinese campaign. This article uses grounded theoretical research methods for data collection and analysis, combining observational data with literature data, and analyzing and sorting out the general application principles of information technology such as big data in China's epidemic prevention and control, which provides information for large-scale emergency disasters. A comprehensive theoretical framework not only provides China's experience in the management of epidemic prevention and control in other countries, but also has guiding significance for the management of large-scale emergency disasters in the future.

Keywords

Grounded Theory; COVID-19; Big Data Technology; Epidemic Prevention and Control; China's Experience.

1. Introduction

1.1. Unprecedented Challenges Brought By the Epidemic

The spread of the new coronavirus pneumonia coronavirus is astonishing. It took MERS about two and a half years to infect 1,000 people, SARS took about 4 months, and the new coronavirus pneumonia reached this number in only 48 days [4]. The urgency of the new crown pneumonia outbreak poses a huge challenge to various resources such as medical treatment and transportation. The direct impact on the economy is also concentrated in various industries such as transportation, retail, tourism, catering, and entertainment. With the continuous spread of the epidemic, on January 30, 2020, the World Health Organization announced that the outbreak of COVID-19 constitutes a public health event of international concern [3]. At this stage, various countries and regions have participated in the prevention and control of the epidemic. The global pandemic of the epidemic has brought unprecedented challenges to the global economy. U.S. stocks melted, crude oil plummeted... the overall impact has plunged many countries into turbulence that is rare in history.

1.2. Strong Support for Information Technology in the Epidemic

Way pointed out that the use of information technology can improve the ability of emergency management agencies to coordinate complex systems, thereby improving the ability to respond

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to disasters [2]. When web-based information technology tools are used for emergency disaster response, we can obtain effective information from them, and obtain near-real-time results through interactive data processing and analysis to assist in various decision-making and coordination in epidemic prevention and control. As the foundation of information technology, big data has the distinctive characteristics of huge volume, diverse data types, fast processing speed and low value density. It is widely used in epidemic tracking, traceability and early warning, auxiliary medical treatment, reasonable allocation of resources and auxiliary decision-making The application can fully cooperate with the "smart war epidemic" [5]. Just like real-time predictive risk maps, social media communication reports, and communicators' trajectory maps across time and space using population travel data, the use of these data provides us with timely and clear dynamic reports on virus transmission. Although the application of information and communication technology in this epidemic has also encountered disadvantages such as network information security issues, big data and other information technologies have made great contributions to disaster response in the epidemic.

2. Literature Review

Whenever a sudden large-scale disaster occurs, it often causes a large number of personal injuries and the destruction of social resources. Without adequate preparation for disasters, complex factors such as the uncertainty of unexpected events, the urgency of time, and the shortage of resources will make us face multiple challenges in dealing with disasters. Among them, disaster response work has a high demand for "information" that will greatly affect the overall effectiveness. As technology plays an increasingly prominent role in society, some frameworks have been proposed to help understand the concept of emergency management information. Drabek pointed out that the use of information technology can improve the complex intergovernmental system capabilities of emergency management agencies, thereby improving the ability to respond to disasters [1]. Way also emphasized that wireless communications, social media, and social networks are increasingly being used to support information collection and coordination [2]. General Secretary Xi Jinping pointed out at the meeting to coordinate the promotion of the prevention and control of the new crown pneumonia epidemic and the deployment of economic and social development, and pointed out that it is necessary to make full use of methods such as big data analysis to support the prevention and control of the epidemic. Nowadays, digital information technology has contributed a lot to the prevention and control, anticipation, decision-making, notification, and resumption of work and production of the epidemic in China. As the epidemic continues to heat up globally, more and more scholars have done detailed research on the application of big data technology in the epidemic. Luyin pointed out that the three major advantages of big data applications in the epidemic are mainly in the integration of systems, auxiliary medical care and reasonable configuration [5]. Ni Sijie summarized in China Science Daily that big data technology has made great contributions in epidemic prevention and control prediction, social think tanks for information integration, and assistance in medical applications [6]. The big data war "epidemic" model presented by Huang Mingke and others mainly explained the application of big data from five aspects: the origin, flow, prediction, configuration, and resumption of production [7]. Wang analyzed the big data analysis and forward-looking monitoring of Taiwan's response to COVID-19, and pointed out that the epidemic response work is a steady transition from "awareness of crisis" to "management of crisis", clarifying that the application of big data is also divided into different stages , The perception of crisis scenarios is the primary task of response to the epidemic [15]. This requires that the content of epidemic prevention and control work should be adjusted in time to follow the development of the epidemic. Zhang's measures for the prevention and control of the epidemic in China are divided into individual, social and national levels [16]. This is a nationwide anti-epidemic campaign, but it also points

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out that the rational deployment of prevention and control by policymakers is the most important, and society and individuals must actively cooperate.

The above-mentioned scholars' research covers most of the scope of big data applications and reasonably divides the application sectors, but the logical connection between each sector is lacking, such as the time sequence of epidemic prevention and control or emergency response process sequence. Reflected in research. Most research scholars lack a systematic and comprehensive summary of the prevention and control of big data technology in the epidemic. They only divide and summarize the areas where big data technology is most widely used, but they can provide experience for future generations. Summary research should have a systematic model and general application principles. And few scholars have elaborated on the shortcomings of big data applications in the epidemic. Due to the complicated development of the epidemic over time, this has left a blank for the supplement and improvement of later models.

Based on the above considerations, this article adopts a grounded theoretical approach to collect data based on China's experience in epidemic prevention and control, improves the logical connection between application sectors, systematically explains the division of conceptual sectors, and establishes a general epidemic prevention and control based on scientific evidence. The theoretical framework of the principle.

3. Research Methods

3.1. Method Selection

This paper chooses grounded theory as the qualitative research method of this research. Way pointed out that the grounded theory method can be summarized as the iterative and integrated process of data collection, analysis, coding, and conceptualization, and finally a theory [2]. Based on this article, the main goal is to summarize the general theoretical principles of China's epidemic prevention and control experience, and establish a basic theoretical framework by dividing and conceptualizing data and information. Moreover, the design of the model framework in this paper is based on the richest possible data and information of China's epidemic disaster response. The grounded theory is based on the coding and conceptualization of data and information, such as the breadth of research data coverage and the credibility of evidence for data conceptualization. It has gone through a reasonable information integration process. The general theoretical principles established by selecting grounded theories also provide exploratory development space for the follow-up supplement and development of the theory. Therefore, the characteristics of grounded theory research methods are highly in line with the needs of the current stage of research, and the later research results also show that the choice of grounded theory is in line with the expected results.

3.2. Data Collection

According to grounded theoretical research, everything involved can be regarded as data, and researchers are also encouraged to collect data in a variety of ways [2]. Therefore, for this research, we mainly start to collect as much relevant information as possible involving keywords, which basically covers the period from the outbreak of the epidemic to the peak of the epidemic to normal control. Information and data are mainly obtained from two channels. The first source of data is the actual data officially announced by the government, such as the WTO, the National Health Commission (National Health Commission of the People's Republic of China) and the Health Commission of the People's Governments of various provinces, autonomous regions, and municipalities in my country. Official website and other officially released data. The second data source is the summary or corresponding research that other researchers have done before, such as newspapers, documentaries, academic research,

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government surveys, etc. Considering that the authenticity of the epidemic information has a great impact on the guidance of public opinion, this article excludes the vast majority of unauthorised unofficial release data, interviews, field surveys and other diverse first-hand data, and the reasons for the use of second-hand data It is also to eliminate suspicious data and obtain data information that has been verified, which provides better information support for the conceptualization and coding of subsequent data information.

3.3. Data Conceptualization and Coding

Table 1. Derivation of the conceptualization of medical assistance

Secondary coding concept	Initial concept	Data Sources
Medical assistance	Integrate existing scientific research data to promote research	Academician Zhong Nanshan's team published in the Journal of Thoracic Disease, "Prediction of China's COVID-19 (New Coronary Pneumonia) Outbreak Trends Based on SEIR Optimization Model and AI on Public Health Interventions", the results of this research are integrated around January 23 Based on the analysis of population migration data and the latest COVID-19 epidemiological data [11].
	"Monitoring" and "Monitoring" of Auxiliary Medical System	After the information manager enters the latest diagnosis and treatment plan into the clinical auxiliary diagnosis and treatment system produced by big data in time, the clinical auxiliary diagnosis and treatment system can automatically make a preliminary judgment on the disease based on the results of various instrument tests, and promptly remind the doctor and the patient's condition (10].
	Reasonably coordinate the division of medical resources	The emergency material management system using big data analysis can help 140 hospitals complete the connection of scarce materials in less than 20 days, and conduct statistical analysis of the overall material situation of hospitals across the country through big data and data visualization [11].
	Improve the efficiency of medical testing	Alibaba Dharma Institute and Alibaba Cloud realized 20 seconds accurate judgment based on CT image data of new coronavirus pneumonia on February 15. Guangzhou Supercomputing Center and Sun Yat-sen University Affiliated Hospital quickly refreshed this record to 15 seconds, thus enabling the technology Race against time to save more lives from death [11].
		Medical research and wireless network analysis based on big data analysis technology promote the use of big data analysis and machine learning algorithms to help outpatients improve work efficiency and ease resource constraints in medical institutions [11].
	Clinical treatment service support	Big data is used in clinical practice to obtain large-scale vital signs data of critically ill patients and normal to severely ill patients, and store the data to make a critically ill patient database and a normal to severely ill patient database [10].
	Drug development and evaluation	In the stage of determining the direction of drug research and development, drug research and development institutions can also use clinical trials, metabolomics, proteomics, genomics and other data on the basis of evaluating the big data of medical records to determine the personalized treatment principles of the drugs to be developed[14].
	Assist health policy making	In the context of medical and health big data, through the establishment of three major database sharing platforms and sharing mechanisms for the entire population, health records and electronic medical records, data aggregation, system interconnection and information sharing in the health and medical field can be realized. Based on the information system platform and relevant health data of various departments [14].
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The conceptualization of the data generated in the data generally requires a level-by-level coding, from generating concepts, developing theoretical concepts, establishing connections between concepts, and finally constructing theories. From the first-level coding, this article breaks up the searched data, assigns specific small-scale attributes and dimensions to the data, and extracts 177 initial concepts from the 37 collected data, and some specific processes are passed (table 2[17]) Demonstration. In the second-level coding, this paper focuses on discovering the organic relationship between existing data, and divides the temporarily determined attributes in the first-level coding into different dimensions. Lin Jingjing pointed out that the focus code is more directional and selective, which helps researchers to screen out the most important initial concepts [8]. Three-level coding This article focuses on searching and determining the core main line in the previous initial concept, and assigns all the determined categories to the core category according to the correlation logic and dimensional system. Through screening, 31 genera and 8 core concepts were synthesized. The preliminary idea of coding laid the foundation for the model framework. (Part of the coding process is shown in Table 1, and other coding processes will not be elaborated in detail due to space limitations).

4. Results

4.1. The Organic Association of Core Categories

From the acquisition of the initial concept, it can be concluded that the deployment of epidemic work always changes with the development of the epidemic. For example, big data collects and analyzes population data at the beginning of the epidemic to focus more on the “prediction” of the epidemic. Most of it is a response to an emergency disaster outbreak; and as the epidemic heats up, the data collection of big data on the population focuses more on the "monitoring" of the epidemic, and more of it belongs to the coordination and integration of epidemic information. Considering that the development of the epidemic is always dynamic and timeliness is very important, and in order to distinguish that the same big data technology application may have different usage effects at different stages, this study uses the core category concept as the correlation between the development time of the epidemic event Attribution was made and three categories were integrated, namely disaster response, process coordination, and decision-making implementation.

4.2. The Concept of Core Generics

4.2.1. Disaster Response

Response is explained in this article as "reaction". Disaster response is a series of responses to disasters when an emergency disaster suddenly breaks out, including but not limited to human response, response to adjustable resources, response to emergency mechanisms, and response to government decision makers. Wait. As of January 26, 2020, 30 provinces across the country have activated a first-level public health emergency response mechanism [16], and the activation of emergency response mechanisms in various regions of China is synchronized with people’s awareness of disasters. According to the data, the perception and awareness of disaster situational awareness has an important impact on people's general perception of disasters. Among them, official announcements are particularly important for emergencies that have been confirmed by data, not only corrections and corrections to public opinion. Guidance and timely deployment of anti-epidemic work has laid a solid foundation and centering pin.

When the understanding of the epidemic is not comprehensive enough, the response also includes traceability and detection. The objects that use big data traceability and detection can be divided into viruses and virus-carrying populations. The traceability and detection of the virus is to better grasp the new crown. Pneumonia is an unknown area of the new virus so that

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humans can better prevent and control the new crown pneumonia; the traceability and detection of the virus-carrying population is to grasp the trend and scope of the spread of the epidemic, promptly investigate suspected cases, and improve the efficiency of epidemic prevention and control.

After performing the above operations, the application of big data technology has also been estimated in terms of risks and resources. The risk estimation has made data analysis on the expected loss of disasters, etc., which not only provides strategic deployment of various industries in the epidemic. The direction also provides the government managers with the direction of epidemic prevention and control, and the resource estimation is to facilitate the reasonable allocation and mobilization of resources that can be adjusted or supplemented when resources are scarce, so as to prevent social panic or epidemic caused by social resource shortages in the later period. Prevention and control are difficult.

4.2.2. Process Coordination

Coordination is the most critical step in epidemic prevention and control. This is the time when the entire society needs effective information most, and it is also the period when big data technology is most widely used. This article divides this core category into three sub-categories, namely resource allocation, system integration and auxiliary medical care. Whether it is materials, technical resources or human resources, the epidemic has developed to this stage the most unbalanced social resources. Resources in various regions require statistical analysis of data to provide a plan for decision makers, and big data will be reasonably allocated to the most optimized according to the needs of each region. The resource allocation plan, and the docking and allocation of balanced resources are also intelligent and efficient information integration based on the analysis results of big data. Big data statistics are used in social assistance and government subsidies at home and abroad.

In terms of system integration, a dynamic database is built for population information or social affairs information in a certain area, and the development of the epidemic can be predicted through modeling. This can provide scientific and authoritative decision-making basis for epidemic prevention and control command decision-makers at all levels. Nowadays, there are more and more voices from the media. In order to find effective information more efficiently in the mixed information, big data can filter information, grasp the tendency of public opinion, and better guide the positive aspects of epidemic prevention and control from the perspective of public opinion. . Speeding up cooperation among all walks of life in terms of data sharing will not only help maximize the integration of effective information about the epidemic, but also find new useable value of information across fields.

In terms of medical assistance, big data mainly cooperates with other new-generation information technologies to serve medical care, reducing manual work, and using data detection and data investigation to improve the intelligent operation of medical care and the accuracy of medical care, and help the laboratory. Some data, scientific research cooperation and exchanges, the interaction between industry and academia, and the intersection of disciplines will collide more sparks of wisdom to improve the efficiency of rescue scientific research, and provide great help for the drug development and technical support of new coronary pneumonia.

4.2.3. Decision Implementation

The entire epidemic prevention and control work is closely related to decision makers at all levels of epidemic prevention and control command. High-quality model analysis results help decision makers optimize decision-making plans and make reasonable decisions. The issuance of official policy documents has always been the focus of the most attention of the public, and the content of these policy documents is far from being supported by reasonable and reliable data analysis results. Including the sharing of technical data to fight the epidemic with other

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regions and countries, and the public sharing of anti-epidemic data is the basis for strengthening multi-party cooperation. As China's epidemic has crossed the turning point and has developed into normalized prevention and control, the big data detection mechanism for the epidemic still cannot be slackened, but the resumption of work and production in the recovery phase must be carried out in an orderly manner in accordance with the results of big data analysis.

General application of big data technology

4.3. Defects in Big Data Applications

4.3.1. Data Coverage Is Not Comprehensive Enough

The application of big data is mainly operated on mobile communication devices, but for many poor or remote areas with low information coverage, or many people who are not capable of interacting with mobile communication devices, such as children, the elderly, and the disabled, they often It is impossible to use communications to retain data and information, and areas and populations that cannot be covered by these big data will inevitably become a weak link in the prevention and control of the epidemic. How to respond to the help of those who are excluded by information technology has become a difficult problem that must be solved in the application of big data in epidemic prevention and control.

4.3.2. Information Privacy and Security Issues

The security issue of information technology has long attracted everyone's attention, and the issue of privacy has been highlighted in the information technology's prevention and control of the epidemic. Including the sharing of multi-party data, it reduces the security of personal privacy. When the data stored in the basic communication service is exchanged or analyzed, the risk of personal information leakage increases. For example, the "health code" of regulatory technology used in epidemic prevention and control has contributed to epidemic monitoring and early warning, but there is still room for exploration on how to grasp the balance between data utilization and personal information protection.

4.3.3. Uneven Levels of Data Quality

Nowadays, everyone is the media. The advancement of information technology has made it easier for the public to speak out, and its timeliness is sometimes even higher than that of the official media, but it has resulted in a large amount of low-quality information entering. The view of the masses can easily lead to following the public opinion of the people who lack judgment. With the development of the epidemic, timely, true and effective information is highly demanded. How to quickly obtain effective information from a large amount of noisy information and data to assist in epidemic control has become a challenge for the application of digital information technology.

4.3.4. Blocking of Data Sharing

In an era when data is no longer lacking, accurate analysis results can be obtained with effective information, but data utilization does not maximize efficiency. Information islands of data still exist and are distributed in large numbers. The division of events and spaces prevents the sharing of many data. For example, the inability to communicate data between governments and enterprises has reduced the utilization of data. How to break information islands and open up data connections has become another major challenge for current data applications.

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5. Summary

5.1. Theoretical Contribution and Practical Significance

This paper adopts the general application model of Internet and communication big data in China's epidemic prevention and control based on grounded theoretical research, provides a basic theoretical framework for the emergency management system experience of data prevention and control in the epidemic, and provides follow-up theoretical research in this field. The development and improvement of the model provides the basis and supplements the gaps in the study of non-systematic exposition of experience summaries. This model is based on China's experience in epidemic prevention and control. As of the completion of the article, the situation of epidemic prevention and control in some parts of the world is still not ideal. As the first country in the world to break out of new coronary pneumonia, China has now normalized epidemic control. Its experience is worth learning from other regions and countries in the world, and the general application model of big data in the epidemic situation summarized in this article provides a digital epidemic prevention and control theory for countries and regions that are suffering from the epidemic.

5.2. Limitations

This article is limited by time, space and other conditions. The source of the research data is only second-hand data. The research results lack the supplement and exploration of primary data, and the first clue to the epidemic situation is missing in this article. Secondly, because this article excludes most of the data information that is not officially authorized, the data information of social public opinion is deemed to be absolutely subjective, so some data, such as the hot search news presented by Weibo based on big data, are ignored.

Secondly, because China's epidemic prevention and control results are not only supported by digital information technology, the advantages of the system and cultural background are one of the factors that improve the situation of China's epidemic situation, but the cultural background and social systems of different countries and regions are very different. Different, one-way research on the results of information technology on the epidemic may exaggerate its effect, so the application of the model needs to be adapted to local conditions.

5.3. Future Research Directions

With the gradual normalization of epidemic prevention and control in China and the warming of the epidemic in some other countries and regions, time differences, spatial differences, cultural environment differences, technological differences, and the degree of variation of the virus in different periods will bring new challenges to epidemic prevention and control. The theoretical model also needs to be replaced with the concept of development. The research in this paper is mainly to integrate and summarize the general principles of the application of big data technology in China's experience in epidemic prevention and control. Considering that there are many types of applications of information technology in epidemic prevention and control, and most of them are composite applications of information technology such as "big data + AI", "Big Data + Cloud Computing", "Big Data + Blockchain", etc. Therefore, the research direction of the follow-up model should not only continue to improve the existing basic model, but also focus on the macro level to summarize and summarize the information The technology summarizes a more comprehensive model in the application of emergency response systems for large-scale emergency disasters. Secondly, the scope of the application of technology in the epidemic should be gradually expanded from only studying China to studying global anti-epidemic experience.

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