

Public Health Governance Policy Optimization Based on Health Big Data

Yuanmeng He

Durham University, Durham, DH1 3LE, UK

Abstract: The application of healthcare big data has great significance for changing the healthcare model, enhancing service efficiency, improving service quality, and meeting people's needs. With the development of information technology and the popularization of intelligent devices, healthcare big data will usher in a new period of application development, and the public health governance policy system will also enter a new stage of improvement and optimization. This paper combines the core functions of health big data in public health governance, and puts forward a path of optimization for public health governance policies with a focus on health big data, which can help to enhance the digitalization and comprehensive competitiveness of public health governance.

Keywords: Big Data; Public Health; Governance Policy.

1. Introduction

With the rapid development and wide application of the Internet of Things (IoT), mobile Internet and cloud computing, the data accumulated by society as a whole will grow further, and the understanding of how to explore and utilize this data to enhance governance has become an important topic of concern for scholars. It is difficult to respond to public health emergencies by relying only on traditional prevention and control methods, so it is imperative to build a public governance system driven by big data and intelligent decision-making. Existing studies have shown that the application of health big data in public health governance not only helps in disease prediction and prevention, but also can effectively innovate the methods of public health governance and strengthen disease control. [1] In the era of big data, data is becoming the "new oil of the future", presented in the form of resources in public governance. Big data is not only a new technology, but also a new mode of thinking, and the change of this way of thinking helps to reveal the regularity of public management and decision-making and optimize social and public health governance policies. [2]

2. Conceptual and Theoretical Foundations

2.1. Health Big Data

Health big data refers to the collection, organization and analysis of health-related data on a large scale. This data can include medical records, biosensors, gene sequencing, health device monitoring data, social media data, and more. The use of health big data can reveal the health patterns, risk factors and disease trends of a population, providing valuable information for medical decision-making, disease prevention and personalized treatment. The application of health big data can provide personalized medicine, which enables personalized diagnosis and treatment plans based on an individual's genome and health records, improving medical outcomes and patient satisfaction. Additionally, it also contributes to the innovation of medical treatment, and health big data provides rich resources for medical research, which

can explore new disease mechanisms, discover new treatments and drugs, and promote the progress and innovation of medical science. [3]

2.2. Public Health Governance

Public health governance refers to the protection of public health and well-being through the formulation and implementation of health policies, planning and measures. It is a comprehensive management system that includes the cooperation and efforts of a number of participants, including government departments at all levels, health institutions, community organizations and citizens. The objective of public health governance is to provide comprehensive health services and protection, prevent and control the spread of diseases, and promote the overall development of people's health. [4] It involves the following aspects: the first is health policy and law, which looks at formulating and implementing policies and laws conducive to public health and to safeguard the public's health rights and interests. The second is health surveillance and reporting, establishing a sound disease surveillance and reporting system to keep abreast of and respond to epidemics and public health emergencies. The third is the prevention and control of infectious diseases. This is in addition to vaccination and immunization, health education and publicity, environmental hygiene and food safety, and medical and health services.

2.3. Theory of Data Governance

Health big data governance theories refer to the management principles and methods proposed for the collection, processing, analysis and application of health big data. Common health big data governance theories mainly include: transparency and privacy protection. [5] Transparency refers to the process of collecting and processing health big data to ensure the transparency of the source and use of the data, i.e., clearly informing affected parties about the purpose of data acquisition and following the principles of data protection. Privacy protection is important for preserving the rights and interests of individuals, including anonymization or de-identification processing, data security measures, and authorization-only access, etc., data security and risk management. The security of health big data

is an important part of guaranteeing the integrity and confidentiality of individuals. Secure technical measures, such as data encryption, access control and authentication, are taken to ensure that data are not illegally accessed, altered or leaked. At the same time, risk management is conducted to assess and manage potential data security risks during the data collection and application process and take appropriate control measures; data quality and standardization and ensuring the quality of health big data is a prerequisite for the effective use of data.

3. Core Functions of Health Big Data in Public Health Governance

3.1. Public Health Monitoring

Health big data plays an important role in public health detection. Public health detection aims to monitor and control the spread of diseases to protect public health and safety. The application of health big data in public health detection can improve the efficiency of disease surveillance, individual risk assessment, medical resource optimization, disease research and public education, which plays a key role in better protecting public health and safety. [6]

(1) Disease Surveillance and Early Warning

By collecting and analyzing large-scale health data, it is possible to monitor the spreading trend and geographic distribution of diseases in real time, detect and warn of possible outbreaks in a timely manner, and help public health departments to take timely control measures.

(2) Individual Risk Assessment

Through the collection of individual health data, it is possible to assess the risk of individuals. For example, based on genomic data and lifestyle habits, as well as other factors, we can predict the probability of an individual suffering from certain diseases, so that preventive measures can be taken in advance.

(3) Optimization of Medical Resources

By analyzing health big data, it is possible to understand the incidence rate of diseases in different regions, the situation of medical consultations, as well as other significant bits of information, which can help the public health sector to optimize the allocation of medical resources, improve the efficiency of resource utilization, and make more accurate decisions. In addition, health big data can provide more comprehensive data support for disease research, thus accelerating scientists' understanding of diseases and the discovery of innovative treatments.

(4) Public Education and Health Management

Health big data can be used to educate and guide the public, such as providing personalized health management advice to help the public better prevent diseases and improve their lifestyles.

3.2. Disease Prediction Models

A public disease prediction model is a model that utilizes big data technology to predict the incidence, prevalence, and other information of a certain disease. It is usually based on the analysis of a large amount of medical data, health data, as well as a mix of similar relevant data. This is then used to build a prediction model through machine learning and statistical learning, so as to predict the epidemic trend of a certain disease, the incidence rate in a particular region, the incidence rate of a certain population, as well as other relevant information, in order to formulate targeted disease prevention

and control measures. Public disease prediction models can use data from large-scale influenza cases, combined with climate season, population movement and other factors, to predict the incidence trend and transmission path of influenza, and provide prevention and control recommendations for relevant departments and the public. [7]

3.3. Finding Virus Hosts

Using health big data to find virus hosts is a very effective method to accelerate the research, prevention and control of viruses. In the process of using health big data to find virus hosts, the first step is to determine the type and characteristics of the virus, different viruses have different hosts and transmission routes, so it is necessary to determine the range of potential hosts according to the type and characteristics of the virus; secondly, it is necessary to collect and analyze data. Data is collected and analyzed using big data technology in order to find out the potential hosts of viruses; and then, it is necessary to establish a prediction model to make predictions of unknown data based on known data; and then further verify the hypothesis, according to the prediction results, sampling and testing of potential hosts to verify whether it is a viral host or not. [8] Finally, it is important to develop preventive and control measures, based on the results of the study. Preventive and control measures for the virus host include monitoring animals and the environment, and carrying out vaccination. It should be noted that the search for virus hosts is time-consuming and resource-intensive, and thus requires the concerted efforts and cooperation of the government, academia and the general public.

3.4. Promoting Public Communication

Health big data are used in public health governance to convey health information to the public through the release and analysis of health data and to raise public awareness and consciousness of diseases. For example, by analyzing big data, it is possible to understand the incidence trend and transmission path of a certain disease, thus reminding the public to strengthen preventive measures. At the same time, it can also optimize health services. By analyzing health big data, medical institutions can better understand the public's health needs and preferences, so as to better allocate resources to the general public. For example, medical institutions can analyze big data to understand patients' consultation habits and disease characteristics, so as to formulate consultation and treatment plans that better meet the public's needs. [9]

In addition, through the use of health big data, the public can better understand their own health conditions and risks so as to better manage their personal health. For example, by using smart health apps, the public can understand their own body indicators and health conditions, and thus formulate more appropriate healthcare plans. Health big data can also provide rich data resources for medical research and education, thereby promoting the development of medical science. For example, medical researchers can analyze big data to study the mechanisms of disease occurrence and treatment methods, thereby improving the standard and quality of medical care.

4. Optimization Pathways for Health Big Data-driven Public Health Governance Policies

4.1. Building a Big Data-assisted Decision-making System for Public Health Policies

The construction of a public health policy big data-assisted decision-making system requires support and investment in many aspects. The first is to establish a data platform, collect and analyze data related to public health policy, including data in various fields such as medical care, disease control, social security, education, scientific research, etc. Establishing an integrated data platform can provide standardized data interfaces and data governance services. The second is to carry out data cleansing and integration. Various types of collected data are cleansed and integrated to ensure the accuracy and consistency of the data, and, at the same time, categorized and labeled to facilitate the subsequent analysis and utilization of the data.

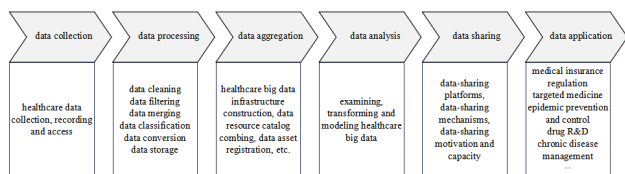


Figure 1. The process of applying big data to health [10]

Thirdly, analytical models should be established. Big data analysis technology should be utilized to establish analytical models for public health policies, including disease prediction models, health risk assessment models, and medical cost-effectiveness analysis models. Through these models, the hidden information and laws in the data can be deeply excavated to provide a scientific basis for decision-making. Fourthly, a decision support system is developed to integrate the analytical models. The system can extract relevant data from the data platform according to the user's needs, calculate and analyze them through the analytical model, and generate visual charts and reports, which provide intuitive and quantitative support and reference for decision-making. Finally, promotion and application will be carried out, and the developed decision support system will be promoted and applied to various fields of public health policy, providing all-round support for policy formulation, implementation and evaluation. At the same time, through the feedback and evaluation mechanism, the system functions and performance will be continuously optimized and improved, so as to enhance the practicality and reliability of the system.

4.2. Building a More Resilient Public Health Governance System

An efficient public health governance system is the basis for the effective application of big-data health management. On the one hand, it is necessary to strengthen the construction of public health infrastructure, improve the coverage and level of medical facilities, and improve the balanced distribution of, and accessibility to, medical resources. At the same time, a sound public health emergency response mechanism should be established, including epidemic monitoring, prevention and control, and emergency response, so as to improve the capacity and level of response to public health emergencies (As shown in figure 2).

On the other hand, it is necessary to establish a sound legal system for public health, improve public health laws and regulations, clarify the responsibilities and obligations of all levels of government and relevant departments, and strengthen legal enforcement and supervision to ensure the standardization and legalization of public health governance. This also strengthens public health education and publicity, improves the public's health awareness and self-protective ability, and cultivates good hygiene habits and a sense of social responsibility. In addition, the promotion of scientific and technological innovation in public health will also help to build an efficient public health governance system, promoting the in-depth integration of the public health cause with modern science and technology, improving the level of disease prevention, diagnosis and treatment, and providing scientific and technological support for public health governance.

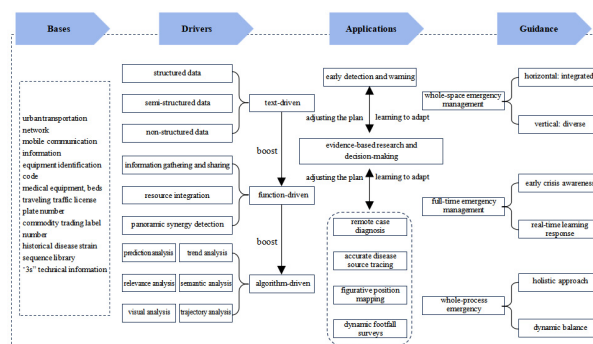


Figure 2. Big data technology-driven public health smart governance framework structure [11]

4.3. Establishing a Standardized and Normalized System for the Use of Big Data

(1) Setting Public Health Data Standards

In order to realize the sharing and exchange of public health data, it is necessary to formulate unified public health data standards, clarify data formats, indicators and exchange rules, etc., to ensure that data between different systems and different fields can be compatible and shared. It is also necessary to establish a sound data governance mechanism, combine the synergistic public health governance framework (as shown in the figure 3) and work in strict accordance with the responsibilities and processes of data management to ensure the standardized use and safe management of data.

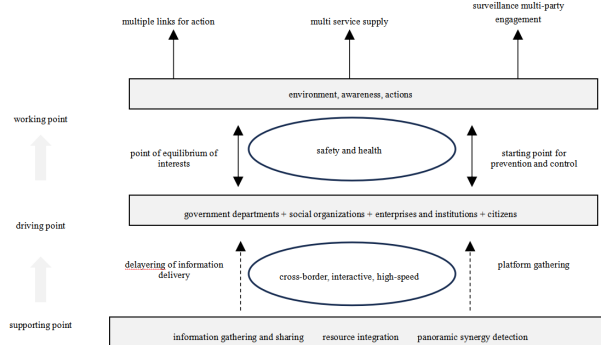


Figure 3. Operational framework for synergized public health [12]

(2) Establishing Data Quality Assessment and Review Mechanisms

Quality assessment and auditing are carried out for different sources and types of data to ensure the accuracy, completeness, and consistency of the data. At the same time,

a data quality feedback and correction mechanism should be established to identify and resolve data quality problems in a timely manner. In addition, it is necessary to monitor and evaluate the entire process of collecting, organizing, analyzing, and using public health data, so as to identify problems and make improvements, and to ensure the scientific and standardized use of data.

(3) Developing a System for Data Analysis and Decision Support

Using big data analysis technology, a public health data analysis and decision support system will be established to provide a scientific basis and visual support for public health decision-making through the exploration and analysis of massive amounts of data. At the same time, it can also promote the sharing and application of public health data by opening up data interfaces and establishing data sharing platforms, strengthening cooperation, and exchanging with relative fields to realize the comprehensive application and cross-border integration of data.

5. Conclusion

To sum up, public health governance in the era of big data will further move towards precision and synergy. The refinement of government services and the improvement of governance capacity require the precise identification of public needs and governance issues, which indicates the importance of big data and related technologies. With the help of big data, government departments will more accurately understand their own operations and deficiencies, as well as the group characteristics and differentiated needs of their service recipients, and make clearer and more accurate judgments on social problems at both the macro and micro levels, and the establishment and analysis of relevant models will help government departments explore the correlation and influence, thus enabling the public health governance to move further from experience to science.

References

- [1] ZHANG Weidong, CHEN Xipeng, YANG Shihan. Construction of value mining analysis framework for healthcare big data [J]. Library and Information Service, 2023, 67 (15):35-43. DOI:10.13266/j.issn.0252-3116. 2023. 15. 004.
- [2] CA H ,M H ,G M . Data is the new oil. How Covid-19 boosted information transparency in Austria[J]. European Journal of Public Health,2021,31(Supplement3).
- [3] Hiba A ,Zahi J . Toward a smart health: big data analytics and IoT for real-time miscarriage prediction[J]. Journal of Big Data,2023,10(1).
- [4] Sun Y. Research and Analysis on the Evolution and Development Dilemma of Emergent Public Health Governance in the United States[J]. Academic Journal of Humanities & Social Sciences,2022,5(18).
- [5] Dimitrios G K ,E H W ,J C G , et al. Ethical and Information Governance Considerations for Promoting Digital Social Interventions in Primary Care.[J]. Journal of medical Internet research,2023,25.
- [6] Carmen K ,Katja K ,Susanne B , et al. Results and Strategies for a Diversity-Oriented Public Health Monitoring in Germany[J]. International Journal of Environmental Research and Public Health,2022,19(2).
- [7] Anusha A ,Saradhi V T . Research challenges and future directions towards medical data processing[J]. Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization,2022,10(6).
- [8] Yanhua X ,Dominik W . MC-NN: An End-to-End Multi-Channel Neural Network Approach for Predicting Influenza A Virus Hosts and Antigenic Types[J]. SN Computer Science, 2023,4(5).
- [9] Klara D . Public Health Communication in France during the Spanish Flu and the COVID-19 Pandemic: The Role of Experts[J]. European Journal of Language and Literature Studies,2023,9(2).
- [10] XU Huan, PENG Kangjun, WEI Na. Forecasting empowered decision-making: A programme from traditional models to big data - Insights from the trend research of the new crown epidemic[J]. Journal of Public Administration, 2021, 18(04): 116-125+173. DOI:10.16149/j.cnki.23-1523.2021.04.001.
- [11] Ma Haiyun, Yang Jinghong. Public governance change driven by big data: basic logic and action framework[J]. China Administration, 2018(12):42-46. DOI:10.19735/j.issn.1006-0863. 2018.12.08.
- [12] Zhou Limin. Global agenda and action framework for public health crisis governance[J]. Journal of Beijing Administrative College, 2023(05): 41-53. DOI:10.16365/j.cnki.11-4054/ d. 2023. 05.013.