

Innovation of Public Health Management Model in the Big Data Environment

Hanzhong Liang

University of York, Britain, UK

Abstract. In the era of Big Data (BD), PHM is facing unprecedented changes and opportunities. This article discusses the innovation of Public Health Management (PHM) mode under the BD environment, points out the challenges faced in this process, and puts forward corresponding solutions. Through the introduction of innovative models such as data-driven decision support system, inter-departmental collaboration and information sharing, and precise public health intervention, the potential of BD technology in improving PHM efficiency, optimizing resource allocation, and strengthening disease prevention and control is demonstrated. This innovation process also faces challenges such as data privacy and security, data quality and accuracy, shortage of technology and talents, cross-departmental coordination problems and lagging laws and regulations. Therefore, this article puts forward a series of targeted countermeasures in order to provide guidance for the future development of PHM and promote the sustainable progress of global public health undertakings.

Keywords: Big data; Public health; Data driven; Management innovation.

1. Introduction

In today's information society, BD has become a key force to promote innovation and development in various fields. Especially in the field of PHM, the application of BD not only changed the traditional management mode, but also provided more accurate and scientific decision-making basis for policy makers [1]. With the surge of data and the rapid development of technology, how to innovate PHM mode in BD environment to improve management efficiency and effectiveness has become an urgent problem to be studied [2]. PHM, as an important part of maintaining social health and preventing diseases, is self-evident [3]. The traditional PHM model often relies on limited data samples and manual processing methods, which greatly limits the refinement and response speed of management [4]. However, with the rise of BD technology, PHM has ushered in an unprecedented development opportunity. BD technology can process and analyze massive data and reveal the laws and trends hidden behind the data, thus providing a new perspective and means for PHM [5].

The purpose of this study is to explore the innovation of PHM mode under the BD environment. Through in-depth analysis of the application status, challenges and potential opportunities of BD in PHM, this study will propose a new PHM model based on BD. This model will make full use of the advantages of BD technology to realize the intelligence, refinement and efficiency of PHM, so as to better cope with public health emergencies and improve public health.

The innovation of PHM model in BD environment is not a one-step process. It requires researchers to constantly explore and optimize, not only to make full use of the advantages of BD technology, but also to be alert to the risks it may bring. It is foreseeable that BD technology will play a more important role in future PHM. It can not only improve the efficiency and accuracy of management, but also help us to better deal with various public health emergencies.

2. Innovation of PHM mode in data environment

In the BD environment, the innovation of PHM mode is particularly urgent and necessary. By integrating BD technology and PHM concepts, PHM can be promoted to be more intelligent and refined.

2.1 Data-driven decision support system

Traditional public health decision-making is often based on limited data and empirical judgment, but in the BD environment, a data-driven decision support system can be built to provide a more scientific and accurate basis for policy making [6]. This system can collect, integrate and analyze data from multiple channels in real time, including medical institutions, social media and mobile devices, so as to provide more comprehensive public health information. Table 1 shows the spread of influenza epidemic in a certain area of the United States through BD analysis. Through such data analysis, decision makers can adjust prevention and control strategies in time and allocate resources to areas with serious epidemic situation more effectively.

Table 1 Analysis of influenza epidemic situation in a certain area of the United States

Time period	Number of new cases	Propagation velocity	Main transmission area
January 2024	120	Medium	City center
February 2024	230	Fast	Urban centers and suburbs

2.2 Inter-departmental collaboration and information sharing

The PHM model in BD environment emphasizes cross-departmental collaboration and information sharing. By breaking departmental barriers and realizing real-time sharing of public health information, the emergency response speed and resource utilization efficiency can be improved [7]. Health departments can share data with education, transportation, public security and other departments, so as to have a more comprehensive understanding of the population flow and the risk of disease transmission. Table 2 shows an example of cross-departmental information sharing. Through cross-departmental information sharing, a more comprehensive and accurate public health information network can be constructed.

Table 2 Example of cross departmental information sharing

department	Type of shared information	Purpose
Health department	Epidemic data and patient information	Epidemic monitoring and prevention and control
Education department	School epidemic report and student health status	Campus epidemic prevention and control
Traffic department	Passenger flow data, transportation hub epidemic situation	Risk assessment of epidemic transmission

2.3 Precision public health intervention

Accurate public health intervention based on BD is another innovative model. Through the in-depth mining and analysis of BD, high-risk groups and regions can be identified, thus achieving accurate disease prevention and control. Through accurate public health intervention, the effect of disease prevention and control can be effectively improved, the medical cost can be reduced, and the public health level can be improved. Table 3 shows an example of precision public health intervention.

Table 3 Examples of precision public health interventions

Intervention measure	Target audience	Effectiveness Evaluation
Customized health management plan	Hypertensive patients	Increase blood pressure control rate by 20%
Early screening and intervention	Diabetic patients	Decrease the incidence of complications by 15%

3. Practice and application of innovating PHM mode

With the acceleration of globalization, the public health problem is no longer a challenge of a single country or region, but a common problem faced by all mankind. Therefore, it is particularly important to innovate the practice and application of PHM mode. This section will discuss the international practice cases of innovating PHM model in the BD environment.

3.1 Case analysis of international practice

Singapore has established a complete health data analysis system, which can collect and analyze national health data in real time and provide decision support for policy makers. During the epidemic in COVID-19, the system effectively tracked the transmission path of the virus by analyzing the patient's movement trajectory and health status, which provided strong support for the government to take timely prevention and control measures.

In order to improve the efficiency of PHM, the Australian government has established a national public health information sharing platform. The platform integrates data from different medical institutions and government departments, and realizes cross-departmental information sharing and collaboration. The system improves the response speed of the government to public health events and promotes the rational distribution of medical resources.

In recent years, the British government has vigorously promoted the precision medical plan, using BD and artificial intelligence technology to provide patients with personalized diagnosis and treatment programs. The plan provides more accurate treatment suggestions for patients by collecting data such as genome information and living habits of patients. This plan not only improves the quality of medical services, but also reduces medical costs.

3.2 Effect evaluation and continuous improvement

The practice of innovating PHM mode has achieved remarkable results worldwide, which are not only reflected in the specific epidemic prevention and control and the improvement of medical services, but also in the overall progress and improvement of the public health system.

Data-driven decision support system has shown strong forecasting and analysis ability in practice [8]. Taking Singapore's health data analysis system as an example, the system can collect and analyze a large number of health data in real time, and predict the spread trend of diseases through accurate algorithms, which provides strong support for government decision-making. This data-based decision-making method not only improves the scientificity of decision-making, but also makes the prevention and control measures more timely.

The establishment of public health information sharing platform has strengthened the information communication and collaboration between government departments [9]. Australia's public health information sharing platform is a typical example, which integrates data from different departments and institutions and realizes real-time sharing and updating of information. This not only improves the response speed of government departments to public health events, but also promotes the rational allocation of resources.

The implementation of precision public health interventions, such as the precision medical plan in Britain, has brought more personalized and efficient treatment programs to patients. This intervention method is based on BD and artificial intelligence technology, which can make targeted treatment plans according to the specific situation of patients, thus improving the treatment effect and the quality of life of patients [10]. This concept of precision medicine is gradually changing the traditional medical service model and pushing the whole medical industry to develop in a more personalized direction.

Although the innovative PHM model has achieved remarkable results, it is still necessary to remain vigilant and constantly improve these models to meet the new needs and challenges. Therefore, it is necessary to continuously strengthen data quality management to ensure the accuracy and integrity of data; Furthermore, further enhance cross-departmental coordination ability and strengthen communication and collaboration to meet more complex public health challenges; In addition, plans such as precision medicine should be continuously optimized and updated, and the latest medical research results and technologies should be applied to practice, so as to improve the level of PHM.

4. Challenges and countermeasures

Data privacy and security issues are difficult problems that need to be given priority when BD is applied to the field of PHM. With the popularization of BD technology, the collection, storage and transmission of personal health information all involve privacy issues. Once the data is leaked or abused, it not only seriously infringes on personal privacy, but also may undermine social trust [11]. Therefore, management departments must strengthen data protection through legislation, establish strict data security standards, and apply cutting-edge encryption technology to ensure data transmission and storage security. Furthermore, a sound data use authorization mechanism should be established to ensure that sensitive data is only accessible by authorized personnel. Regular data security training is also essential to improve the data protection awareness and emergency response ability of relevant personnel.

The quality and accuracy of data are also issues that management departments must face up to. The effectiveness of public health decision-making is based on accurate and complete data. However, there may be various interferences in the process of data collection, collation and analysis, which will further affect the authenticity of the data. In order to solve this problem, practitioners should establish a strict data quality control mechanism from the source of data. Using advanced data cleaning and verification technology to preprocess data to improve its quality. Furthermore, it is also the key to ensure the accuracy of data to strengthen the training of data management team and improve their professionalism and data processing ability.

The shortage of technology and talents is another problem that needs attention. With the continuous progress of BD technology, the demand for relevant talents is also increasing. In order to solve this problem, management departments should work closely with universities and vocational training institutions to jointly cultivate professional BD talents. Furthermore, actively introduce external experts and resources to provide technical support and consultation for public health departments. In addition, a perfect incentive mechanism should be established to encourage employees to improve themselves to meet the needs of the era of BD.

In the BD environment, how to achieve cross-departmental collaboration and information sharing is also a big challenge. In order to break the barriers between departments, management departments need to establish a unified platform and standard for information sharing. Promote effective communication and cooperation among departments through clear cooperation mechanism and benefit distribution scheme. Furthermore, strengthen publicity and education on the importance of information sharing, and improve the understanding and support of various departments.

Facing the lag of laws and regulations, we should strengthen the legislative work and constantly improve the relevant laws and regulations system. The legislature should pay close attention to the development of BD technology and formulate and revise relevant laws, regulations and policies and measures in a timely manner. Furthermore, strengthen law enforcement and the construction of supervision mechanism to ensure the effective implementation of laws and regulations.

In general, the innovation of PHM model in BD environment faces multiple challenges. In order to meet these challenges and promote the sustainable development of public health, management departments need to put forward specific solutions and suggestions from data privacy and security, data quality and accuracy, technology and talents, inter-departmental collaboration and information sharing, and laws and regulations. By constantly improving relevant mechanisms and measures, practitioners can better meet future challenges and promote the continuous innovation and development of PHM model.

5. Conclusions

In the era of BD, PHM is undergoing unprecedented changes. This article discusses the innovation of PHM mode in BD environment, including the application of data-driven decision support system, inter-departmental collaboration and information sharing, accurate public health intervention, and

public health monitoring and early warning system. These innovative models not only improve the efficiency of PHM, but also provide a powerful tool to deal with public health emergencies.

PHM is facing multiple challenges, such as data privacy and security, data quality and accuracy, shortage of technology and talents, difficulty in cross-departmental collaboration, and lagging laws and regulations. These challenges require management departments not only to pay attention to technological innovation, but also to system construction and personnel training, so as to realize the dual promotion of technology and management.

To sum up, BD has brought unprecedented opportunities and new challenges to PHM. Practitioners must embrace these changes with an open mind and build a more intelligent and efficient PHM system through continuous innovation and improvement, so as to better protect public health and cope with various public health crises that may occur in the future.

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