Research on Application of Healthcare Data in Big Data Era

Guijie Li[1]， Yutao Liu[2], Hang Zhao[3], Hengyu Cai[4,*]

1.Department of Otorhinolaryngology Head and Neck Surgery, China-Japan Union Hospital of Jilin University, Changchun, Jilin 130033, P.R. China.
2.Central Sterile Supply Department, China-Japan Union Hospital of Jilin University, Changchun, Jilin 130033, P.R. China.
3.Department of Neurosurgery, China-Japan Union Hospital of Jilin University, Changchun, Jilin 130033, P.R. China.
4.Department of Hematology-Oncology, China-Japan Union Hospital of Jilin University, Changchun, Jilin 130033, P.R. China.
*corresponding author's email:714487815@qq .com

Abstract—**This article takes healthcare big data as the research object. It firstly introduces the source of healthcare big data, summarizes the current application status of healthcare big data, and analyzes the opportunities and challenges facing medical big data thoroughly. The development of big data and processing technologies has enriched the data foundation and analysis methods for healthcare big data analysis. The healthcare big data still faces challenges in the aspects of data cleaning, data security, personnel training, and platform development.**

Key words: Big data; healthcare; data security; internet

I. INTRODUCTION

On June 24, 2016, the State Council issued the Guiding Opinions of the General Office of the State Council on Promoting and Regulating the Development of Healthcare Big Data Applications[1], and put forward major tasks that "consolidate the application basics of healthcare big data, comprehensively deepen the application of healthcare big data, regulate and promote "Internet + health care" services, strengthen the construction of healthcare big data security system. The use of healthcare big data in the national healthcare field has been put on the agenda. However, in China, how to use big data for clinical medical services based on the sharing of electronic health information is still a new topic. There is still a long way to go to strengthen establishment of population health informatization and construction of healthcare big data services system, promote the use of big data in the field of healthcare. The paper intends to briefly introduce the mining and analysis of big data in the field of healthcare, the use of visual analysis tools, and the use of big data in the implementation of precision medical care, to provide reference and assistance for the extensive application of big data in the healthcare field.

II. BIG DATA

Big Data is a term that describes a huge or complex data set. Traditional data processing applications cannot handle it effectively. Challenges faced by big data include analysis, acquisition, data management, sharing, storage, transmission, visualization, querying, updating, and information privacy. Big data often includes data sets that are captured, managed, and processed beyond the usual software tools in tolerable runtime.

Currently, it is difficult to give a strict definition on big data. But it is generally believed that big data has four characteristics: large amount of data, complex types, low value rate and fast rate, which makes the traditional data processing method process big data ineffectively[2]. The development of computer and network technologies, combined with the use of patient monitoring systems and the use and sharing of electronic health record information, enables medical service organizations to collect and store a large amount of patient-related information and process various types of information related to patient health. Extracting valuable information from the patient's mass health information and quickly processing information on the most recent symptoms of the patient create conditions for the use of big data in the healthcare field.

III. THE EFFECT OF BIG DATA ANALYSIS IN MEDICAL AND HEALTH

Big data analysis helps improve treatment to patient, optimize financial management procedures, and save medical resources. For a start, through the accumulation of large amounts of data and real-time analysis, doctors can adjust treatment plans in time to treat patients more specifically; clinical decision support systems that use big data can help physicians make evidence-based, more personalized treatment decision, reducing errors and improving treatment outcomes; big data analytics technology can inquire and mine electronic health information, identify links between various types of information, and combine knowledge-based rules and information to improve existing clinical decision system. Second, big data analysis can also find financial loopholes, allocate resources reasonably[3], and increase revenue. At present, medical institutions find financial loopholes mainly through inspections and audits. However, this method is time consuming and laborious, and errors may occur. Advanced big data analysis methods such as machine learning and predictive models can help financial and audit experts find where the medical payment process is easy to miss and problems may occur, which will greatly reduce audit costs. Thirdly, the data analysis can also be used to determine the impact of the work of each department on the patient's medical treatment time. For

978-1-5386-6580-0/18/$31.00 ©2018 IEEE
DOI 10.1109/ICRIS.2018.00100

example, if the data analysis shows that the time that patient stays in the imaging department is longer than expected, measures need to be taken to shorten the examination time of the patient in order to improve the medical efficiency. Through the analysis of the electronic health information data, it can also be found out which patients really need long-term treatment and which patients should be discharged as soon as possible. This can not only ensure the time required for the patient's treatment, but also prevent the patient from wasting the medical resources due to prolonged occupation of the bed.

IV. THE STATUS OF THE APPLICATION DEVELOPMENT OF HEALTHCARE BIG DATA IN CHINA

A. The medical information construction in early time laid a solid foundation for the development of the healthcare big data industry

Since 2006, China began to build a regional health information platform to integrate various types of data of hospitals, primary health institutions, and public health in the region, and to form an individual-centered computer health archive database. The data mainly includes clinical information—prescription, inspection reports, surgical reports, medical records, discharge summary; public health information—disease reports, disease management, biostatistics, child health, women's health, care for the elderly, etc. After more than a year of exploration, the healthcare big data has initial foundations and scales, and has achieved some landmark results. First, the national level design and overall framework: the construction of population health informationization, released "National Health Insurance Informationization" last phase of the overall data structure. Second, the formulation of national health standards and interconnection: Focusing on interoperability and information sharing, 89 data sets, 277 medical and health information standards, and 3300 data elements with the unique identity of the citizen's ID number have been developed and the national population database is formed. The data is coordinated with information from the public security, education, civil administration, and human resource department and other departments. It covers 1.36 billion people and contains information of 13 items. Third, the fundamental capacity construction of healthcare informatization: At present, 71% of provinces across the country started the construction of provincial health information platform, 46% of prefecture-level cities started the construction of municipal health information platform, and 29% of districts and counties started regional and county-level platform construction[4]. In 2015, The National Health and Family Planning Commission of China launched the interconnection project among 10 provinces. Currently, it has connected ten provincial platforms at hospitals level, such as Shanghai, Beijing, Hunan, Hubei, Jiangsu, Zhejiang, Fujian, Chongqing, Inner Mongolia and Liaoning. About 50% of county-level hospitals, 42% of provincial hospitals and 38% of municipal hospitals have started the construction of hospital information platforms.

B. The state has issued a series of policies to provide a good environment for the development of the healthcare big data industry

Since 2015, the State Council and the National Health and Family Planning Commission and other relevant departments have successively issued a series of guiding documents, proposing the acceleration of healthcare big data related technologies and industrial development, promoting the transformation of medical health service models and management models, and improving the level of medical services in China. This provides a good policy environment for the development of medical big data[5].

V. APPLICATION OF HEALTHCARE BIG DATA IN CHINA

The application prospects of healthcare big data in China's medical and health fields will be very broad, and are specifically expressed in the following aspects.

A. Health Big Data Improves Medical R&D Efficiency

The core of big data technology is to do specialized processing of collected data and discover the relevance hidden between different data. After the processing of health data, personalized analysis of disease, behavior, or emotions of different patients can also be conducted to explore the relationship between the characteristics of the patient's disease and their living habits, and develop different drugs according to patient's disease characteristics or symptoms (targets). At the drug R&D stage, pharmaceutical R&D institutions or companies use health big data technology to analyze the public's disease trends and drug demand, and accordingly determine more efficient input-output ratios and allocate medicinal resources rationally. In addition to lowering R&D costs, healthcare big data can also help pharmaceutical R&D institutions or companies to shorten the time to market for drugs, increase the success rate of drug clinical trials, gain market access, and promote drugs with higher treatment success rates and higher potential market returns to market as soon as possible. According to past experience, it has been found that the use of predictive models can help pharmaceutical companies reduce the cycle of new drugs from R&D to market promotion from about 13 years to 8~10 years. And effective real-time monitoring can be implemented during use.

B.Health Big Data Achieves Scientific Management of Disease Diagnosis and Treatment

With the continuous improvement of people's material living standards, the disease spectrum of residents in our country has undergone significant changes. Hospitals can collect health data of each resident intelligently through a health cloud platform, and provide professional counseling services for patients according to their condition. After further accurate diagnosis of the patient's health status, the expert informs the patient of potential health risks in the future, which can help relieve the patient's medical burden. It realizes the scientific management of disease prevention diagnosis and treatment. At the same time, hospitals and other health institutions can also analyze real-time data generated by telemedicine systems and process the latest data. The use of healthcare big data to analyze the use of

medical resources, help achieves the scientific management of medical institutions and the efficient allocation of medical and health resources, improve the level and efficiency of China's medical and health services. In addition, big data can also enhance medical value, form personalized medicine, combine biological data (such as genes, proteomics, and other related data) with patients' electronic health record data to enable personalized medical care such as gene sequencing, personalized medicine, illnesses diagnosis and treatment to becomes clinical practice[6].

C. Healthcare Big Data Improves Public Health Emergency Management Capabilities

Infectious diseases and major epidemics seriously endanger the lives of the public and social order. The health big data can effectively improve the emergency management capabilities of the public health department. The medical and health department can establish a health management information platform covering the areas under its jurisdiction, collect information and build a database of residents' health information, use the big data technology to conduct real-time monitoring and analysis of public health data, detect infectious diseases rapidly, and conduct comprehensive monitoring of the epidemic. Though early warning and prevention measures according to the epidemic situation monitoring, medical expenses can be greatly reduced and lower the infection rate of infectious diseases and other epidemics. At the same time, the public health department can also provide the public with accurate and effective health counseling services to increase their awareness of health risks and health awareness. This can also reduce the risk of infection and spread of the epidemic to a certain extent. For example, Zika virus, its structure was quickly analyzed under the support of big data and effective prevention and control have been achieved.

D. Healthcare Big Data Improves Risk Analysis Level

Through the Internet and health information systems and related information systems to monitor the health of the public, you can obtain data related to health risk factors systematically and comprehensively, and then through in-depth mining and analysis of big data technologies, the real threat to the health of the public can be found out. The relevant data collected include: biological factors (including monitoring data of pathogenic bacteria, fungi, viruses, etc.), environmental factors (including air, soil, hydrology, etc.), social factors (including income level, population migration, nutrition conditions, education and employment, etc.), psychological factors (including depression, autism, anger, etc.), family genetic factors, health service, individual behavior and other factors. Use big data technology to compare and correlate the collected health risk factors, evaluate the population living in different environments and different social conditions, finally determine the health risk factors, and find out under which kind of specific ecological and social environment, specific diseases are easily to occur according to the identified risk factors. Finally, targeted interventions are carried out in the public's livelihood, to promote the improvement of residents' health standards, and guide the public to consciously change and protect our environment.

E. Healthcare Big Data Effectively Realizes Residents' Health Management

Electronic health records of residents are important basic data for residents' health management. Using big data technologies to analyze can provide residents with personalized health management services and change traditional nutrition and health models. Efficient health services and management can be provided to different residents from different aspects such as environment, nutrition, society, psychology, sports, etc., which effectively help and guide the public to maintain physical and mental health. Moreover, big data technology can also analyze patient health information integratedly, and provide better data evidence for remote diagnosis and treatment of patients through data after analysis, to reduce the patient's psychological pressure. Therefore, the analysis of residents' health data through big data technology can realize intelligent monitoring of residents' physical and mental health, analyze the factors that affect the physical and mental health of residents, and further help residents improve their health management.

VI. CONCLUSION

Healthcare is closely linked with human life. There will be major changes in the way that medical services are delivered in the era of big data. In the new era, China is faced with urgent problems such as aging population, increase in patients with chronic diseases, and increase in medical services. Traditional treatment methods will not be able to solve these problems. Big data provides another solution, which has wide application prospects despite that there are still many challenges ahead. With the development of technology, opportunities will outweigh the challenges and more value of big data will be discovered.

REFERENCES

[1] Dequan Xu, Huiqing Yang. The Application of Big Data on Healthcare Personalized Service [J]. Chinese journal of health informatics & management, 2013, 10(4): pp.301-304.

[2] Gong Peng. The difference of Sino-U.S. precision medicine and its implications for China [J]. Medicine and Philosophy, 2016, 37(8):pp. 26-27.

[3] Hood L, Flores M. A personal view on systems medicine and the emergence of proactive P4 medicine: predictive, preventive, personalized and participatory [J]. New Biotechnol, 2012, 29(6): pp.613-624.

[4] GZ Yang. Body Sensor Networks. 2nd ed. London: Springer-Verlag, 2014: pp.5-7.

[5] Shen Tao, Cui Yong. Expectation and reality for medical big data [J]. China Digital Medicine, 2015, 10 (7): pp.2-4.

[6] Yan Yan, Xingbin Qin. A review of big data research in medicine & healthcare [J]. E-Science Technology and application, 2014, 5(6): pp.3-16.