

Joint Registration System under the Background of Big Data

Run Tian, Pei Yang, Kun-Zheng Wang

Department of Orthopedics, The Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an, Shaanxi 710004, China

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With the increasing frequency of human social activity, the amount of data generated daily is also increasing exponentially. The recording medium of information has changed from the oldest carved stone to the current semiconductor carrier, which also pushes forward the progress of society. This also moves society into the big data era (BDE), in which all things can be data. BD has helped people make many breakthroughs in political decision-making, economic policy, and more, and thus affects the human knowledge system and way of life.^[1] The choice is no longer dependent on subjective judgment using imagination, but a large digital network in series consisting of habitual movement, physical movement, consumption, or medical record. In the medical field, many public databases are funded by the government and open to all researchers. BD for use in genomics, oncology, and proteomics provides resources and information that make healthcare and disease prevention more personalized and the digitalization of medicine unstoppable.^[2] The convergence of digital and medical is inevitable, and the current changes have appeared to be a good start.

Joint registration systems have been implemented in many countries. Sweden was the first country to achieve joint registration.^[3] The implementation of the joint registration system not only improves patient management, but also provides strong data support for prosthetic screening and design, surgical technique improvement, and secondary refurbishment. Sweden's experience was subsequently carried out in the Nordic countries. As the source of the world's largest annual joint surgeries, the United States also launched the national joint registration system in 2001. As noted in the annual report, the joint registration system effectively reduced the chances of joint renovation, which significantly saves in social medical expenses.^[4] After decades of development, surgical cases and techniques on joints in China have reached the world's top levels.

However, there is still no relevant data available on Chinese joint surgery.

BIG DATA

BD refers to the large-scale data that cannot be analyzed by current mainstream software tools. These data achieve the capture, management, processing, and organization of information in a reasonable time, to help researchers obtain more active information for decisions.^[5] From another point of view, BD is a large complex number and structure. The type of data is composed of data collection, data processing, and applications based on the cloud computing model. Through the integration of data sharing, cross-multiplexing the formation of intellectual resources and knowledge service capabilities, BD serves for future. In-depth application of BD in many industries and disciplines, including biomedical research methods, have brought significant changes.^[6] Statistical methods are often used to process and analyze data from scientific experiments or clinical studies. To analyze the accuracy of the results, the number of samples is increased, which also increases the cost. The combination of technologies, which includes networking, cloud computing, and cloud storage, and traditional medical methods makes biological research more convenient and quicker to obtain new breakthroughs, while the cost of obtaining these results also declines.^[7] For example, Google predicted the popularity and outbreaks of Influenza A (H1N1), based on user search content in 2009, which offered very valuable data for public health agency officials.^[8] The Shenzhen national gene pool contained 1.3 million copies, of which 1.15 million copies were

Address for correspondence: Dr. Kun-Zheng Wang,
Department of Orthopedics, The Second Affiliated Hospital of Xi'an
Jiaotong University, Xi'an, Shaanxi 710004, China
E-Mail: country_side@126.com

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human samples, animals, plants, and microorganisms, and 150,000 copies were other samples. By the end of 2015, traceable biological samples were expected to reach 30 million biological samples. The total number of DNA sequences registered in the GenBank database in the U.S. exceeded 28 billion base pairs in 2002. With the continuous development of information technology in medical institutions, as well as information management and the Internet of Things, the data generated in the medical field are increasingly collected and stored by hospital information systems (HISs). The hospital information center stores all data generated by the medical system, including not only medical advice, nursing records, drug use, and other medical data, but all medical staff roles, medical equipment, and management and service personnel.^[9] To achieve the “electronic, informative, digital, and intelligent” requirements of modern hospital information management, the hospital basic data storage capacity should be measured in TB or even PB level. BD applications of the HIS can generally be divided into two types: those for hospital management, such as medication, processes, and other mining and analysis; and those for clinical support, such as clinical scientific research or real-time, assisted clinical support. The data generated in hospital health care offers countless possibilities for medical decision-making.^[10] Of these, a significant portion has not been used, including a large amount of joint replacement data in China.

JOINT REGISTRATION SYSTEM

Artificial joint replacement is currently the gold standard for the treatment of many end-stage diseases of the joints.^[11] The artificial joint replacement has more than 40 years of history in China. At present, the annual number of artificial joint replacements in China is unknown. So far, we have accumulated a large number of related cases. Even though surgery technology on artificial joint replacements is leading in world levels, there is no joint registration system in China. As the first country, Sweden launched a national joint registration system in 1979. Until now, 95% of Swedish joint surgeries are completed by the hospital registration system each year, and a large number of complete joint replacements and renovations of the initial data provide strong supporting evidence for clinical treatments, prosthetic design, and technical improvement.^[12] Since then, some Nordic countries have implemented their own national joint registration system. As the world’s largest hip replacement country, the United States began to create a joint registration system in 2001. Data reports of 2016 show that there are 115,000 cases of hip replacement surgeries in the United States each year, and joint surgeons will complete 12% of the renovations. This is reduced by 50%, compared to the rate before the creation of the registration system.^[4] The reduction in repair rate will greatly ease the pressure on social health. Orthopedic surgeons in China established a joint registration system as early as 2001.^[13] However, it has not yet been achieved because of social conditions,

medical environment, and many other factors. At present, follow-ups regarding joint replacement in China are still conducted by the unit of a single hospital, which not only wastes huge medical resources but also leads to a lack of convincing data on Chinese joint surgery in the international discourse. With the progress of Chinese joint surgery technology and the arrival of BDE, it can be expected in the near future that joint surgical registration systems in China will be gradually be established. A complete set of joint replacement standards and a personalized design, similar to Chinese joints prosthesis and according to China’s own joint replacement, data will also be achieved.

SEVERAL PROBLEMS IN THE PROCESS OF ESTABLISHING A JOINT REGISTRATION SYSTEM

Data sharing issues

The National Center for Biotechnology Information (NCBI) stores massive amounts of data on molecular biology, biochemistry, and genetics. Most of data are freely available to scientists all over the world. According to regulations, if scientists in the U.S. want to obtain government funding, they must apply for it only when they promise that the detailed research data would be provided to the NCBI. This is how the NCBI acquires a large amount of data. Massive scientific research and clinical data accumulated by biomedical research departments and medical institutions in China is still used in the current departments, and data sharing between institutions is very limited. The data island phenomenon limits the improvement of biomedical research efficiency and aggravates the burden of the social health protection system.^[14] The economic burden of patients is increased, due to repeat consumption. Because of interests in possession of medical research data and medical information, most of the institutes have a protective attitude. Social and peer data services are almost impossible. Because of this, it is necessary to establish appropriate policies and measures to require medical research institutions and medical institutions to share data. This is the foundation for biomedical research, national health records, and medical information data platforms, and also the basis for building the joint registration system of China.

Standardization

Due to the vast territory and cultural differences in China, it is much harder to establish a unified electronic medical record system and operation technique, which should have a uniform standard. At present, different information systems between hospitals and scientific research institutions are difficult to unify, mainly due to the differences in the technical standards between the equipment manufacturers, software vendors, and the research methods. The structure of data storage devices of the information centers may also be different, which causes the hospital data to be unable to circulate and share. This creates obstacles for the treatment of the same patient in different hospitals. Joint surgery has been conducted in community hospitals. However,

plenty of joint surgeons have not undergone professional standardization training, leading to great differences in patient status after arthroplasty. Therefore, we must break the technical barriers to solve the problem of information and techniques standardization. Chinese joint surgeons should actively join the national and international standards discussion, and design, develop, and participate more in the information sharing.

Lack of medical data required for complex talents

Medical BD science is a combination of biomedical, information technology, statistics, management, and other disciplines. The talent to master biomedical and information science knowledge is scarce. To promote multidisciplinary research and education, the United States created the Bioinformatics and Computational Biology Center at the University of Delaware in 2009, comprised of more than 60 faculties from five colleges. This center also created and was responsible for multiple bioinformatics education projects. At present, there are very few colleges and universities in our country to establish biomedical research and information. Most of the related talents are self-taught or co-trained by different disciplines in the field of biomedical research or composite research. This phenomenon should cause alert of the relevant medical education managers. It also needs related interdisciplinary talent to build and manage joint registration systems. In most hospitals, the clinicians and medical students conduct the relevant work, which is unfavorable for the establishment of joint registration systems.

The arrival of BDE has brought new changes to the traditional medical industry. Accurate and personalization are the future direction of medical care, and also the direction of joint surgery. The joint registration system under the background of BD is the road sign. Hopefully, a joint registration system with the promotion of BDE can be established soon in China.

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