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Development and Technology Application of Smart hospitals in China

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Abstract: The construction of smart hospitals will help improve the medical experience of patients and the efficiency of doctors. Smart hospitals can also realize medical smart auxiliary diagnosis decisions and effectively promote the improvement of national health standards and the development of the medical field. China is the world's most populous country, and its smart medicine is developing rapidly. The scale of the trillion medical market has a huge economic and market prospect. It is of great significance to adequately understand the construction and development of smart hospitals in China. This paper focuses on the construction of smart hospitals in China, the definition, connotation, and significance of smart hospitals were elaborated, and the problems in the construction of smart hospitals in China. Reviewed the development stages and research status of smart hospitals construction, analysed problems, technologies, and challenges that exist in the construction of smart hospitals. Finally, the three application scenarios of "Smart medical care", "Smart Service" and "Smart Management" were analysed to provide reference for the construction of smart hospitals based on huge data, artificial intelligence, Internet of Things, and 5G technology.

Keywords: Smart hospitals; Big data; Artificial intelligence; Internet of Things; 5G.

1. Introduction

The smart hospitals originate from smart medical. Smart medical referred to as WITMED, which is the rise of the exclusive medical term in recent years. It can realize informatization for patients and medical staff, medical institutions, and medical equipment by the creation of health file regional medical information platform and advanced internet of things technology. Smart medical care generally consists of three parts, namely the "Smart hospitals System, Regional Health System, and the Home Health System" [1]. Although the concept of "Smart hospitals" has only been proposed in the world for more than a decade. However, smart medicine can rely on the Internet, big data, cloud computing, artificial intelligence, and other information technologies to integrate, collect, process, and apply big health data. It can be production after consuming, provide many personalized, efficient, and low-cost medical and health products and services directly to patients. The connection of online and offline medical services through the Internet medical platform can effectively reduce the information asymmetry between doctors and patients. It can get rid of the constraint of scarce medical resources more effectively than traditional medical services.

Chinese Health Commission clarified the concept of smart medical care in 2019, which mainly includes "Smart medical care" "Smart Service" "Smart Management" areas. On May 21, 2020, the "Notice of the General Office of the National Health Commission on Further Improving the Appointment Diagnosis and Treatment System and Strengthening the Construction of Smart hospitals" further explained the overall construction direction of smart hospitals issued by the China Health Commission. It summarizes the practical experience of hospital informatization construction in order to establish a "Trinity" smart hospitals system of medical treatment, service and management. It is important to further play the important role of information technology in modern hospital construction and management to continuously improve the modernization level of hospital governance. It is necessary to build a modern hospital service and management model of "Integration of Network and Actual Work" in order to provide patients with higher quality, higher efficiency, safer and more considerate medical services. Among them, the construction goal of smart service is to take "Electronic Medical Record" as the core and smart service construction as the starting point to further enhance the patient's medical experience. The construction goal of smart medical care is to further consolidate the information foundation of smart medical care with "Electronic Medical Records" as the core. The construction goal of smart management is to further improve the level of refinement of hospital management by means of smart management construction. With the rapid development of the digital economy, China's smart healthcare market is growing rapidly. The global pandemic has made the role of smart medicine increasingly prominent. In the post-epidemic era, the government has attached great importance to AI-enabled medical treatment, which has led to the rapid development of the smart medical industry. According to statistics, in 2020, the investment scale of China's smart healthcare industry in 2021 is around 118.9 billion yuan, up 18.3 percent year-on-year. The investment scale of the sector is expected to exceed 150 billion yuan in 2022, and the industry will enter a period of high-speed growth with intelligent, efficient, and large-scale development.

Therefore, the significance of the construction of smart hospitals also reflects the following points. For medical staff, the construction of smart hospitals is conducive to improve work efficiency, the level of diagnosis and treatment, and the operational efficiency of hospitals. This can not only effectively reduce the work pressure of medical workers, but also allow patients to enjoy more timely, accurate, and high-quality medical services, which can improve the satisfaction of hospitals, medical workers, and patients, and promote the sustainable development of hospitals and the improvement of national health. From an economic perspective, China's aging population is increasingly straining medical resources, and the government and the public are increasingly focusing on the smart medicine industry. At present, China's smart

medical industry has ushered in a good opportunity for development. In the future, smart healthcare will become a "New Driving Force" for the rapid development of China's digital economy.

2. Development stages of smart hospitals in China

In recent years, various Chinese hospitals have explored and built smart medical services at different levels, effectively promoting the development of China's medical informatization construction from the digital hospital stage to the smart hospitals' construction stage. After the relevant literature review and analysis, the development of smart hospitals in China can be roughly divided into four stages.

The first stage is the information exploration stage based on single information management. The early construction of smart hospitals is inseparable from medical informatization. China's medical informatization construction began before 2000, but mainly with the financial accounting system as the main core function. In 1978, the General Hospital of Nanjing Military Region introduced domestic DJS-130 minicomputers and began to explore information technology in drug management and other aspects.

The second stage is the outbreak stage of medical informatization construction based on big data technology. From 2000 to 2010, with the gradual improvement of big data and cloud computing technology, the application of big medical data has been valued worldwide, and medical informatization has ushered in a period of rapid development. In November 2008, IBM proposed the concept of "Smart Earth", including important fields such as smart medical care, smart power supply, smart city, smart transportation, smart logistics, smart agriculture, and smart banking. All walks of life make full use of IT and Internet technology to promote human beings to work and live in a more refined and dynamic way, thereby raising the "Level of Wisdom" around the world. The proposal of "Smart Earth" has promoted the construction and development of smart medical care effectively. The hospital has become an important carrier for the construction of smart hospitals and institutions to implement medical services. In 2010, in order to implement the "Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Medical and Health System" and the "Notice of the General Office of the State Council on Printing and Distributing the Work Arrangements for the Five Key Reforms of the Medical and Health System in 2009", the Ministry of Public Health of China organized and formulated the "Basic Specifications for Electronic Medical Records (Trial)" and other policy to strengthen the management of electronic medical records in national medical institutions, standardize the clinical use of electronic medical records and promote the informatization construction of medical institutions. It marks the beginning of China's hospital construction from information construction to smart hospitals construction.

The third stage is the stage of smart hospitals technology realization under the development of artificial intelligence, the Internet of Things, and other technologies. Since 2011, the Internet of Things industry has been listed as a strategic emerging industry in China. Cloud computing, 5G, Internet of Things, AR, VR, and other innovative technologies emerge in an endless stream [2]. In order to provide efficient, accurate, high-quality medical services, most hospitals try to integrate the above technologies with the business scenarios to achieve the purpose of improving the efficiency of hospital operations, providing convenient medical services for patients, and reducing the workload of doctors. The goal is also successively appearing in the construction plan of large general hospitals. For example, in 2011, the PLA General Hospital proposed to promote the transformation of hospital development goals from large-scale comprehensive hospitals to research-oriented smart hospitals. Standardized electronic medical records and smart service standards have provided direction for the construction of smart hospitals.

The fourth stage is the all-round layout construction stage under the Healthy China 2030 development plan. Since 2015, based on standardizing electronic medical records, the Chinese government has continuously introduced relevant policies for the construction of smart hospitals, such as the "Healthy China 2030" planning outline issued in 2016, which laid the foundation for the all-round layout of China's smart hospitals construction. In 2019, the Chinese government standardized the standard system for the hierarchical evaluation of hospital smart services and improved the appointment diagnosis and treatment system. It emphasizes the development of smart medical care based on innovative technology and highlights the use of information combined with innovative technology to improve medical standards, to strengthen the construction of smart hospitals. With the rapid development of the digital economy, the scale of China's smart medical market is growing at a high speed, ushering in a good opportunity for development. With the impact of the COVID-19 pandemic in 2020, the advantages of the Internet medical industry have been fully reflected. The web-based health care almost covers the major industrial fields, including medical service, health management, diet (food hygiene and nutrition), but also includes the environment, pension insurance, the combination of medical care and care. Therefore, in the future, promoting and standardizing the application of big data in health care will promote the release of production capacity in medicine, finance, logistics, pension, insurance, education, and fitness, and help accelerate the transformation and upgrading of the health industry.

In summary, the smart hospitals are the product of the development of "Medical Informatization" to an advanced stage. The construction process of smart hospitals in China is not long, mainly concentrated around 2010. It originated from the construction of medical informatization. The innovation of IT technology and the support of national policies are the main driving factors for the implementation of smart medical construction.

3. Results and discussion

Although the medical level in China's big cities is developing rapidly, the medical level is highly uneven among regions, and the medical service level in some remote areas is highly backward. It is difficult for people to obtain timely and high-quality medical services. In order to enable people in remote areas to have high-quality urban medical resources, Internet hospitals and telemedicine come into being. Internet technology has been used to share information between different hospitals or hospitals and patients, which can considerably reduce the possibility of unnecessary traffic, accommodation, travel, and disease delays. However, there are still various problems in the current medical information technology. For example, an ambulance for remote pre-treatment has network functions and can realize real-time

video calls. But due to the limitations of network structure and medical information equipment, there is a certain delay in medical scenarios such as remote video. Moreover, at present, most medical institutions do not optimize the information function for specific medical scenario applications, so it is difficult to adapt to a wide variety of medical information services. The development of smart hospitals will solve the problem of health care and health services, meet the medical service needs of the broad masses of people, and realize the innovation and application of medical and health services.

3.1. Problems in the construction of smart hospitals

Relevant literatures show that the development of smart medical care industry in developed countries and regions such as Europe and the United States is relatively mature, and the construction of smart hospitals is earlier. Among them, the United States is an advanced country in smart medical care. More than 40% of the world's smart medical equipment is produced in the United States, especially large imaging diagnostic equipment, implantable medical equipment, remote diagnosis equipment and surgical robots, etc. The technology of smart medical care equipment is at the world's leading level, and plays an important role in the construction of smart hospitals in the United States. For example, the utilization of information technology to directly provide telemedicine by medical institutions, remote pathological diagnosis and treatment, and telehealth services to patients has become a normalized and large-scale application in the United States. Japan is the second largest consumer market for smart medical care. As a highly aging society, there is a strong demand for smart medical care products related to elderly diseases, including pacemakers, artificial heart valves, vascular stents, insulin pumps, and artificial joints. The construction of smart hospitals in China began relatively late.

Through combing and summarizing, it is found that the problems in the construction process are mainly focused on the following three aspects.

Firstly, the construction standards for smart hospitals have not yet been unified at the national level. Due to the inconsistent level of medical informatization in various provinces and cities, the direction and focus of hospitals in the process of building smart hospitals in various places are also different. The level of informatization construction is not uniform, resulting in limited data uniformity and sharing. It is impossible to achieve cross-institutional medical and health information integration, which is not conducive to doctor-patient referral, medical resource sharing and regional collaborative treatment [3].

Secondly, as far as most hospitals in China, the development of smart hospitals is still in a relatively basic stage. The main job is on the information collection and data combining of various business scenarios of the hospital, and the current smart hospitals doesn't bring real convenience to doctors and patients. It doesn’t provide top-level design services for smart medical care effectively. Most hospitals have not yet realized the functions such as telemedicine, intelligent accompaniment, rational use of drugs, hierarchical diagnosis and treatment, clinical auxiliary decision support and so on. Therefore, improving patients' medical experience and hospital medical service level, effectively shortening patients' medical treatment time, and improving doctors' work efficiency will be the focus of the construction of smart hospitals at present.

Thirdly, the construction of smart hospitals lacks interdisciplinary talents that have hospital business knowledge and are familiar with IT technology. In the process of constructing a smart hospital, it is necessary to put forward intelligent design for the hospital's medical environment, medical resources, and medical services to achieve the best diagnosis and treatment effect. For example, the pre-hospital and in-hospital connections for emergency patients are effectively connected to save treatment time and achieve the best treatment effect. However, at present, there is a great shortage of talents who are familiar with the intelligent computer process and the hospital business process, which also makes the construction of smart hospitals unable to be truly implemented.

3.2. Main technologies and challenges for the construction of smart hospitals

Smart medical care, smart services and smart management are important scenarios for the construction of smart hospitals in China. The technologies involved cover big data, cloud computing, artificial intelligence, Internet of Things, mobile Internet, 5G and so on. Among them, big data and artificial intelligence technology are the technical support for the effective realization of the main scenarios of smart medical care, including application scenarios such as "Clinical Auxiliary Decision Support", "Clinical Data Center", "Image-assisted Diagnosis" and "Rational Drug Use Support". 5G and mobile Internet technology provide technical support for application scenarios such as "Intelligent Guidance", "Telemedicine", "Appointment Registration" and "Regional Collaborative Treatment" for "Smart Services". "Smart management" such as "Material Management", "Financial Management", "Medical Device Management" and "Digital Operating Room" are inseparable from Internet of Things technology (Banerjee, Chakraborty, & Rathi, 2020). According to the relevant data of China's National Health Commission, the telemedicine development rate of China's tertiary hospitals has reached 74%, mainly based on remote consultation. Most of them have not realized regional collaborative treatment and resource sharing of medical supplies and personnel. In the following parts, the technologies to realize the application of smart hospitals scenarios are discussed.

3.2.1. Big Data and Artificial Intelligence

Big Data refers to the need for new processing models to have stronger decision-making power, insight, and process optimization capabilities to adapt to massive, high growth rates and diversified information assets [4]. In "The Age of Big Data", written by Victor Mayer-Schönberg and Kenneth Kukye, big data refers to the use of all data instead of a shortcut such as random analysis (sampling). IBM proposed the 5V characteristics of Big Data, including volume, velocity, variety, value, and veracity. McKinsey Global Research defines "Big Data" as a collection of data that is so large that it greatly exceeds the capabilities of traditional database software tools in terms of acquisition, storage, management, and analysis, and it has four characteristics, including massive data scale, rapid data circulation, diverse data types, and low value density.

Artificial Intelligence is a new technical science used to simulate, extend the theory, method, technology, and application system of human intelligence. The development of artificial intelligence is divided into three stages: computational intelligence, perceptual intelligence, and

cognitive intelligence [5]. The first is computational intelligence. Robots began to calculate and transmit information like humans, such as neural networks, genetic algorithms, etc.; The second is perceptual intelligence. Perception is to include vision, speech, language, the machine begins to understand and understand, make judgments, take some actions, such as speakers that can understand speech, etc.; The third is cognitive intelligence, where machines can think like humans and take the initiative to act, such as driverless cars that drive completely independently and robots that act autonomously.

Smart medical care is one of the three major directions of smart hospitals construction, and its intelligent realization is inseparable from the technical support of big data and artificial intelligence technology applications. Its applications can be divided into three categories: analysis, decision support and execution.

Analytical applications are mainly based on the rule base to prompt medical staff, and the rule base is generally derived from standardized documents such as clinical paths, clinical guidelines, authoritative literature, and department routines.

Decision support applications are mainly provided auxiliary decision-making opinions for medical staff, integrating NLP, knowledge graph, machine learning, deep learning, and other technologies to carry out real-time intelligent reasoning and decision-making. For example, clinical big data analysis provided clinical auxiliary decision-making suggestions for doctors based on image data and clinical text data. Among them, in the application of clinical text data, the application of the Clinical Decision Support System (CDSS) is the most typical. In terms of the application of image data, it is the most typical image-assisted diagnosis of artificial intelligence. Taking CDSS as an example, CDSS uses authoritative medical guidelines, clinical pathways, textbooks, etc. as the support of the knowledge base, and models based on real-time full clinical data, which can provide clinical decision support for doctors.

Executive applications work in collaboration with healthcare workers. Executive applications involve a wide range of technologies, integrating multidisciplinary knowledge and techniques. Medical robotics are one of the typical applications. Medical devices are an important auxiliary tool for the implementation of smart medical care, and they are also advanced products in the field of multidisciplinary interdisciplinary research. Taking the surgical robot as an example, due to the need to combine a large amount of surgical data and the optimal control of human-computer interaction in the clinical treatment process, the "Surgical Brain" of the robot is formed. Large tertiary first-class hospitals in China have widely implemented clinical applications based on surgical robots [6]. For example, the Affiliated Drum Tower Hospital of Nanjing University introduced da Vinci robots in 2014, and in the first three quarters of 2020 alone, the volume of da Vinci robot surgeries in the urology department of the hospital reached 3504 cases, with an average of nearly 400 cases per month.

Although the activity of intelligent applications in the field of smart medical care is relatively high, there is a certain distance between them and actual clinical needs. At present, the application of big data and artificial intelligence in this field has the following two problems. First, the quality of data is poor. Although the amount of data in the medical field is huge, massive data is not equal to massive high-quality data, and problems such as incomplete data, inconsistent data, and unreasonable data hinder the penetration of technology. Second, the modality of the data is very simple. The current intelligent application is mainly single-modal data, multi-modal data application is less, and the fusion of multi-source knowledge is lacking.

In the future, with the improvement of the data base, the intelligent application in the field of smart medical care will show the following development. First, the analytical application gradually improves the medical logic, and the underlying medical knowledge graph is used as the logical support [7]. Second, decision support applications will form a decision support system that integrates multi-source knowledge in the future. In terms of image data application, a decision support system covering multiple diseases, multiple sites and the whole process will be formed, and a decision support system of "Authoritative Knowledge + Clinical Experience" will be formed in the application of clinical text data [8]. Third, with the continuous progress and integration of multidisciplinary technology, executive applications will also further mature and develop in the direction of human-machine collaboration.

3.2.2. Internet of Things Technology

The Internet of Things is the third revolution in the information technology industry, originating in the field of media. It refers to a network that connects any object to the Internet in accordance with the priory agreed communication protocol through radio frequency identification, sensors, infrared sensing, global positioning, laser barcode scanning, image recognition, and other information sensing equipment. The object exchanges and communicates through the information dissemination medium to achieve intelligent identification, perception, positioning, tracking, and supervision.

An important goal of the construction of smart hospitals is to provide smart medical care services. Internet of Things technology provides a new technical means for the smart service that integrate diagnosis and treatment, management and decision-making. The core of the medical Internet of Things is still the Internet, which connects the sensors of multiple information devices in hospitals through networks to enable information transmission, information exchange and resource sharing. The application of smart service in the construction of smart hospitals is mainly based on the perception layer and network layer technology of Internet of Things technology, and "Smart Management and Precision Medicine" is the main application direction at present.

The smart management function mainly includes information management, hospital management, blood management, and device management. For example, in large hospitals, it is common for patients to wait for medical treatment for a long time and information was prone to error. The use of a smart medical system can reduce the time for patients to wait for medical treatment, and patients can make appointments through the hospital's WeChat public account, query and download their own tests, examination results and physical examination reports, etc., which facilitates patients' visits, follow-up visits and self-health management [9]. The use of radio frequency identification (RFID) technology of the Internet of Things has applied to the process of patient information identification. The hospital can store the patient's personal medical information in the RFID device, medical staff can quickly obtain the patient's medical information by scanning the RFID device. The patient's medical information is timely conveyed to the doctor's hands, which is conducive

to take timely and reasonable rescue measures for the patient.

Precision medicine is embodied in the application of RFID technology to the medical examination process. Medical staff can allocate corresponding RFID devices to patients to achieve automatic management, avoid the occurrence of accidental pick-up and misplacing, and improve the efficiency of medical examinations. In the process of mobile nursing, medical staff can monitor the patient's vital sign indicators in real time through RFID equipment to achieve remote dynamic monitoring, which is conducive to medical staff timely discovering abnormalities in the patient's physical condition and immediately assisting the patient [10]. The Internet of Things has been prescribed to the planned application and medical and health system, and the hospital can realize the visibility management of the hospital and improve information transparency through the monitoring system under the Internet of Things and the smart medical system. This means that the patient's treatment can be monitored all the time, and the patient's physiological and pathological indicators can be monitored at any time through the software, and the doctor can be reminded. At the same time, the Internet of Things technology can also deal with the epidemic situation in a timely manner, and the accuracy of each link of prevention and control can be adjusted. Now that the COVID-19 epidemic around the world is repeated, hospitals will have hundreds of thousands of people every day, and they need to take strict care of patients' visiting rooms and waiting rooms. Through the Internet of Things program, patients and suspicious people in important areas can be better monitored to ensure the safety of hospitals and patients' medical environment. This implements intelligent, humanized and precise management of hospital personnel, equipment, logistics and safety guarantees, effectively saves social resources, and greatly promotes the comprehensive development of medical and health undertakings [11].

However, the application of Internet of Things technology in smart hospitals is still in its infancy. The application of the Perception Layer technology of the Internet of Things is mainly used for the collection of medical information and data to avoid errors in information, but there are still many deficiencies in the application of telemedicine and virtual simulation. Therefore, holographic reality and digital twins based on Internet of Things technology may become the direction of development in the future. The technology is a three-dimensional holographic reconstruction to achieve a realistic reproduction of virtual objects, which can achieve human-computer interaction effects within reach. Holographic reality technology can provide detailed images of the patient. The degree of refinement can reach the position of being able to distinguish between different blood vessels, and it is also more vivid in medical teaching. It is used in surgical treatment and telemedicine, which has great significance for the development of modern medicine. Digital twins make full use of physical models, sensor updates, running history and other data, integrate multi-disciplinary, multi-physical quantities, multi-scale, multi-probability simulation processes, and complete mapping in the virtual space, thus reflecting the whole life cycle of the corresponding physical equipment [12].These new technology applications will enable real-time monitoring of devices and even individual components on devices on each Internet of Things node by building a medical Internet of Things platform. On the one hand, this can achieve cost reduction and efficiency improvement of remote after-sales service, and on the other hand, it can dig deep into the machine operation data to help the hospital better manage the equipment.

3.2.3. 5G technology

5G technology is not only an upgrade of 4G network technology, but also a qualitative leap in communication technology. One is that the communication rate can reach 10Gbit/s, which is more than 20 times higher than 4G. Moreover, the wireless delay is less than 5ms, which is more than 10 times higher than 4G. And the number of connections can be increased by 10 to 100 times [13]. Furthermore, the connection density is one million per square kilometer, with an increase of 10 times. As a result, 5G is the best service infrastructure to connect the healthcare industry.

5G network slicing technology is to split the same 5G physical network into multiple virtual logical networks. The physical network is divided according to business requirements such as latency, bandwidth, security and reliability to adapt to different application scenarios, so as to avoid building a dedicated physical network for each specific service, thereby greatly saving the cost of network construction.

The construction of smart hospitals has three very important functional modules, one is pre-hospital emergency care, the second is auxiliary treatment, and the third is remote diagnosis and treatment. Because 5G technology has the characteristics of faster (Low latency 1ms), wider (High broadband 10Gbps), wider (Internet of Everything million level), MEC (Mobile edge computing), network slicing (Differentiated service requirements), and high-precision positioning (Sub-meter level), it has many application scenarios in the construction of smart hospitals.

The "5G + Medical Emergency" for pre-hospital emergency refers to the medical emergency service implemented through communication and collaboration between emergency medical personnel, ambulances, 120 emergency centers and hospitals based on 5G networks, which can promote the integration of pre-hospital emergency and hospital treatment. In the 5G era, super ambulances equipped with high-definition video communications and equipped with basic medical detection instruments will become a reality, and life characteristic data such as ECG, blood oxygen, and blood pressure will be transmitted to the hospital in real time, saving rescue time. This is a typical pre-hospital first aid application. Based on 5G network and GPS positioning technology, it can realize accurate positioning inside and outside the hospital and promote the scientific scheduling of medical resources.

The "5G + Remote Health Data Monitoring" is based on 5G to implement remote health data monitoring. It can monitor the patient's vital signs in real time, continuously and for a long time, and transmit the obtained vital sign data and critical alarm information to the medical staff on a 5G network. The medical staff collect patients' heart rate, breathing and other signs of physical data through smart bracelets, electrocardiographs, ventilators, sphygmomanometers and other monitoring devices. These data are transmitted by 5G network real-time. The collected patient sign data can be intelligently analyzed and processed. This scenario enables remote doctors to learn the patient's status in a timely manner, judge the condition in a timely manner, and analyze the treatment.

In the "5G + Remote Ultrasound Diagnosis" for assisted treatment, doctors can use robot technology, sensor

technology and communication technology to examine patients by manipulating a robotic arm based on the patient's force feedback information and the patient's video. High-definition audio and video are completed by camera, force feedback information is collected through the robot arm sensor, and remote control is completed by operating the joystick [14]. The scene requires multiple high-definition video transmissions, and doctors not only need to see ultrasound images, but also know the position and orientation of the ultrasound probe in the human body. This scenario can promote the sinking of high-quality medical resources and help graded diagnosis and treatment.

The "5G + Medical Image" is to upgrade the hospital's traditional film to cloud film through the image cloud platform. In the 5G era, multi-user viewing real-time can be realized through regional image sharing, high-speed cloud storage, cloud access, which is also conducive to scientific research and teaching. The establishment of regional imaging centers can effectively promote mutual recognition of test results in the region. It will reduce the economic burden on patients, and reduce the pressure on hospitals to store image data.

"5G + Remote Surgery Teaching System" is a medical form that realizes the archiving of surgical audio and video materials, remote observation and teaching, and expert guidance through the camera to collect and compile and live broadcast the pictures of surgical wounds, operating tables, and medical instruments online [15]. The medical technology level of hospitals in remote areas can be improved through remote surgical teaching, and doctors at the surgical site in remote areas can even communicate in real time through remote surgical teaching with doctors at remote higher-level hospitals during surgery.

The "5G + Remote Consultation" is conducive to the high-speed and efficient characteristics of 5G. It can realize the rapid transmission and simultaneous access of relevant medical data, such as radiological imaging, pathological conditions, electronic medical records, etc. It can also promote the transformation from "Face-to-Face" consultation to video remote consultation. Patients can use 5G technology to communicate with doctors in real time through high-definition video, and transmit monitoring data to doctors at the remote end through wearable monitoring devices, which is convenient for doctors to make real-time diagnosis and consultation [16].

Therefore, real-time data transmission and analysis based on 5G networks can satisfy the flexibility and scalability requirements of people's livelihood projects and personalized testing. It can provide accurate diagnosis and intervention through remote guidance in places where medical resources are scarce (Remote areas, First aid, Natural disaster sites, etc.) [17]. The use of 5G slicing technology will be conducive to the high reliability and low latency characteristics of 5G and MEC computing capacity, thereby ensuring real-time medical and surgical performance, and avoiding patient casualties caused by network delays.

However, there are still many difficulties for the application of 5G in the construction of smart hospitals. First, China implements a strict certification system for medical devices for clinical application. Due to the complexity of 5G industrial chain and immature business model, 5G terminal equipment has not yet achieved commercial popularization, resulting in a generally high unit price of clinical trial equipment. In addition, because of the lack of policy guidance and incentive mechanism, all kinds of medical institutions for risk, cost, and other reasons, are bound to affect the promotion and application of 5G technology at the grassroots level, which needs to be resolved through consultation. The second is the problem of networking. 5G networks need to deploy more base stations, which is about 2 or 3 times than that of 4G base stations. The number of sites is large and the cost is very high, which is not conducive to the full coverage of 5G networks. The third is data sharing and information security. The degree of data standardization between various research and development institutions, enterprises, and medical institutions is not standardized enough, which restricts the value of 5G technology in medical data sharing, exchange, development, etc. In addition, medical institutions generate a large number of medical records, images, and other data every day, involving personal information privacy and security issues. Therefore, the data transmission and sharing process needs to be in a strong information security guarantee, and information security is also the top priority of medical information construction.

4. Conclusion

In conclusion, in the past decade, the popularization of Hospital Information System (HIS) has made the initial informatization of Hospital management in China. Despite this, the development of smart hospitals is still at a relatively basic stage for most hospitals in China, and the relevant construction standards have not been unified at the national level. Although the technology related to the construction of smart hospitals has developed rapidly, there are still many drawbacks such as complex outpatient business processes, poor information sharing between departments, inability of resident doctors to access and enter patient diagnosis and treatment information in real time during rounds, and inability to obtain detailed circulation information of purchased drugs in real time. In the actual construction process, there was a lack of people with both hospital business knowledge and familiarity with IT technology. Fortunately, the development of information technologies such as artificial intelligence, big data and 5G networks provide opportunities for smart hospitals construction. From the perspective of technical realization, smart hospitals can gradually build a telemedicine health service platform that integrates disease prevention, online diagnosis and treatment, and rehabilitation care through technologies such as the Internet of Things, mobile Internet, and cloud computing. Moreover, the applications of smart medical care on the main technologies involved in the construction of smart hospitals are analysed in order to explore the innovative applications of smart hospitals construction, such as big data, artificial intelligence, Internet of Things and 5G. After the study of this project, I summarize the development of smart hospitals in China as follows:

Firstly, advanced information technology is an important way to realize the function of smart hospitals. The construction of smart hospitals takes the protection of the health of all people as the starting point, improves people's medical experience, promotes the healthy development of people's lives, optimizes the allocation of medical resources, and improves the satisfaction of medical workers and patients. The National Health Commission of China divides the smart hospitals construction into three directions, including smart medical care, smart service, and smart management. Big data and artificial intelligence technologies, cloud computing,

Internet of Things, mobile Internet and 5G network technologies are important ways to implement smart hospitals construction and realize smart hospitals functions.

Secondly, there are still many technical problems to be solved in the construction of smart hospitals. Although, preliminary results have been achieved through the application of digital technology in the field of smart medical care at present. However, the application of artificial intelligence, big data, and 5G network technology is not popular or mature, and there are still many problems that need to be solved urgently. The use of big medical data and artificial intelligence to carry out "Smart Medical" intelligent diagnosis decisions is only used in the diagnosis of a few hospitals or individual diseases. There is still a big gap between the goal of building universal health through big medical data. As for the smart service and smart management modules in the smart hospitals, the current work is mainly around the core diagnosis and treatment and the hospital management. There are only a few attempts in chronic disease management, infectious disease prevention and control, intelligent nursing, and residents' health management. Therefore, the construction of smart hospitals has not been truly and comprehensively realized in China, and there are still many problems to be solved and further improved in the intelligentsia of the main application scenarios of smart hospitals.

Thirdly, the construction of smart hospitals around the development of information technology applications may become a way for China to achieve a comprehensive smart medical platform.

In the future construction process of smart hospitals in China, it is necessary to further strengthen the construction of the national population health informatization and healthcare big data service system, standardize and build big healthcare data, build a digital Internet hospital based on mobile Internet and 5G network technology. In the future construction process of smart hospitals in China, it is necessary to further strengthen the construction of the national population health informatization and healthcare big data service system, standardize and build big healthcare data, construction digital and smart Internet hospitals based on mobile Internet and 5G network technology.

On the one hand, the next development goal is to standardize smart medical standards by improving medical data to achieve medical data as a clinical auxiliary decision-making service, intelligent decision-making, improve medical level, build a decision support system fused by multi-source knowledge, and lay the foundation for digital hospitals to move towards intelligent hospitals.

On the other hand, the relevant departments of medical services should deeply explore the application of Internet of Things technology and artificial intelligence technology in the construction of smart hospitals. Through exploring the role of Internet of Things technology and artificial intelligence technology in the construction of smart hospitals and improving the medical ecosystem, to build and realize the smart medical care service from "Inside the Hospital" to "Outside the Hospital" extension. To realize the interconnection, integration, open sharing of government health and medical information systems and public health and medical data, and eliminate information barriers and islands. Improving the ability and level of information governance of population health will provide strong support for building a healthy China and realizing the Chinese dream of the great rejuvenation of the Chinese nation.

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