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The Role of Emerging Technologies in Modernizing the Healthcare Industry: Case Studies from China

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Abstract: In recent decades, digital technology has undergone significant advancements, permeating various aspects of our daily lives and offering numerous conveniences and benefits. In the realm of digital health, technologies such as artificial intelligence (AI), blockchain, and 5G play crucial roles in transforming the medical care landscape. This article aims to explore the potential impact of digital technology on enhancing the medical service experience for both patients and healthcare providers, thereby improving overall service efficiency. The analysis will employ CiteSpace to examine current trends in this area. Case studies from prominent institutions including The University of Hong Kong-Shenzhen Hospital, Peking Union Medical College Hospital (PUMCH), Ruijin Hospital, Shehong First People's Hospital, and The First People's Hospital of Bijie will be used to illustrate practical applications of health technologies in tier one cities. Additionally, examples from Shehong First People's Hospital and The First People's Hospital of Bijie will highlight how digital technologies optimize healthcare delivery in tier four and five cities. Recommendations will be proposed on leveraging emerging health technologies to enhance healthcare solutions, particularly in rural settings.

Keywords: digital health; AI; telehealth; 5G; digital health management; digital health policies; administration management; medical resources

1. Introduction

Burgeoning rapidly around the globe, digital health is broadly defined as "the field of knowledge and practice associated with the development and use of digital technologies to improve health" across the full range of health technologies introduced into care, including telehealth, mobile health apps and wearable technologies, and online health services and tools (Zandi & Kuzmanovic, 2021). Due to the convergence of large new digital data sources, computing power to identify clinically meaningful patterns in the data using efficient artificial intelligence (AI) and machine-learning algorithms, and regulators embracing this change through new collaborations, the future of clinical development is on the verge of a major transformation (Shah et al., 2019). The increasing demand of the public for quality and efficiency in healthcare and the rapid development of technologies such as AI, blockchain, and 5G have led to the emergence of digital health, which is gradually becoming a vital and indispensable role of society (Yu et al., 2023c). The escalating public craving for quality and efficiency in healthcare, coupled with the swift advancement of technologies such as AI, blockchain, and 5G, has given rise to the advent of digital health, which is progressively evolving into a crucial and indispensable element of society (Popescu & Yu, 2024). Digital health has already revolutionized the traditional healthcare system, particularly in the context of the COVID-19 pandemic (Yu et al., 2022a). Telehealth enables the implementation of online diagnosis and telesurgery, electronic health records (EHRs), and electronic medical records (EMRs) to optimize and enhance personal healthcare efficacy. Meanwhile, mobile health (mHealth) applications furnish the public with the convenience of accessing health information, and the application of blockchain concurrently realizes medical data sharing and protection through decentralized technology (Yu et al., 2023a). It is incontrovertible that digital health confers benefits upon stakeholders, including not only patients and practitioners but also application developers and other related firms or individuals. This paper utilizes the

bibliometric software CiteSpace to analyze the current hot spots in the digital health sector and further expound on the current trend of MedTech applications in Chinese hospitals. Simultaneously, policies promulgated in recent years will also be deliberated to illustrate the role the Chinese government has played in the development of digital health. Five hospitals in China – The University of Hong Kong-Shenzhen Hospital, Peking Union Medical College Hospital (PUMCH), Ruijing Hospital, Shehong First People's Hospital, The First People's Hospital of Bijie – are cited as exemplars to demonstrate in detail how Chinese hospitals leverage cutting-edge technology to enhance the quality of the healthcare industry. Paramountly, this paper elucidates how emerging medical technologies implemented in hospitals can facilitate the equitable distribution of medical resources between developed and underdeveloped areas to further optimize the healthcare systems in China.

2. Literature Review

Digital health interventions are widely celebrated due to their low-cost nature and ability to provide tailored person-centered care in communities worldwide (Thompson, 2021). Kukafka (2019) stated that digital health is uniquely positioned to transform health care. Ubiquitous computing and the technological advancements of mobile-computing platforms and wearable consumer devices have enabled continuous monitoring of citizens and their everyday behaviors. This longitudinal data can be mined to disclose physiological and behavioral signatures of existing health impairments and may effectively provide predictive capabilities for health conditions yet to emerge. To maximize the benefits of the adoption and growth of health informatics and digital health, health service managers play a critical role in leading and managing the implementation and transformation of the system, both strategically and operationally, whilst still needing to manage 'business as usual' (Brommeyer et al., 2022).

In 2020, the first year of the outbreak of the COVID-19 pandemic, digital health is a crucial solution to deal with the crisis and a number of people have expressed the same point of view. The public health crisis posed by coronavirus disease (COVID-19) has ignited rapid implementation of digital health care (Crawford & Serhal, 2020). The COVID-19 pandemic accelerated the uptake of digital health worldwide and highlighted many benefits of these innovations (Van Kessel et al., 2022). Digital tools can effectively support institutions during a pandemic by facilitating the immediate widespread distribution of information (Center for Systems Science and Engineering at Johns Hopkins University, 2020), tracking transmission in real-time, creating virtual venues for meetings or day-to-day operations, and providing telemedicine visits for patients (Fagherazzi et al., 2020). Advocacy and adoption of digital solutions have become ubiquitous globally, with national strategies adapted to the stage of the outbreak in different countries. These solutions and underlying strategies will play a role in the transition to living with COVID-19, in ongoing risk assessment, and in helping health services cope with the challenges of global pulsed containment (Chen et al., 2021). Governments around the world have implemented various health policies and interventions in the face of infectious COVID-19 outbreaks. One of the popular tactics is to make use of mobile technologies, such as launching apps (Kim, 2021). Telehealth programs overcome physical barriers to provide patients and caregivers access to convenient medical care and help balance the supply of clinical services with the surge in demand across physical or geographical boundaries (Wosik et al., 2020). In the U.S., COVID-19 is transforming the telemedicine landscape with breathtaking speed. U.S. insurers have quickly expanded coverage to include all telemedicine visit types including from home and states relaxed their licensure requirements for care delivered across state boundaries. In addition to allowing for broad reimbursement of virtual visits, HHS waived enforcement of Health Insurance Portability and Accountability Act regulations to allow the use of consumer audio and video communication for telemedicine visits (Mann et al., 2020). China has a sizeable urban-rural health gap (Bhaskar et al., 2020), providing great potential for the expansion of telemedicine. It has been predicted that in the coming years, online healthcare platforms are projected to see drastic increases in market share, particularly following COVID-19, with companies supplying

direct-to-patient telemedicine subscriptions such as Good Doctor, Alibaba, and Tencent experiencing dramatic growth (Wang, 2018).

Now, in China, digital health, an emerging health service model with a cross-industry integration and application of information technologies, such as mobile internet, cloud computing, big data, and AI (Zhou & Chen, 2021), is fast developing. According to data published by IQVIA (2019), the market size of China's digital health management sector has reached almost 200 billion yuan by 2020. With the growing self-awareness among Chinese people in relation to health matters and the continuous progress of digitalization, it is expected that the market size of this industry will undergo further growth in the forthcoming years, exceeding 240 billion yuan in 2024. Due to the disparities between different regions of China, pandemics or public health crises may lead to underdeveloped areas being unable to handle the poverty of medical resources. While the application of emerging digital technologies can alleviate the burden, there are numerous benefits to promoting digital health. These include enhanced access to information, the provision of previously unachievable care, improved access to services and increased care delivery, enhanced professional education, quality control of screening programs, and reduced healthcare costs (Hong et al., 2020).

3. Citespace Analysis

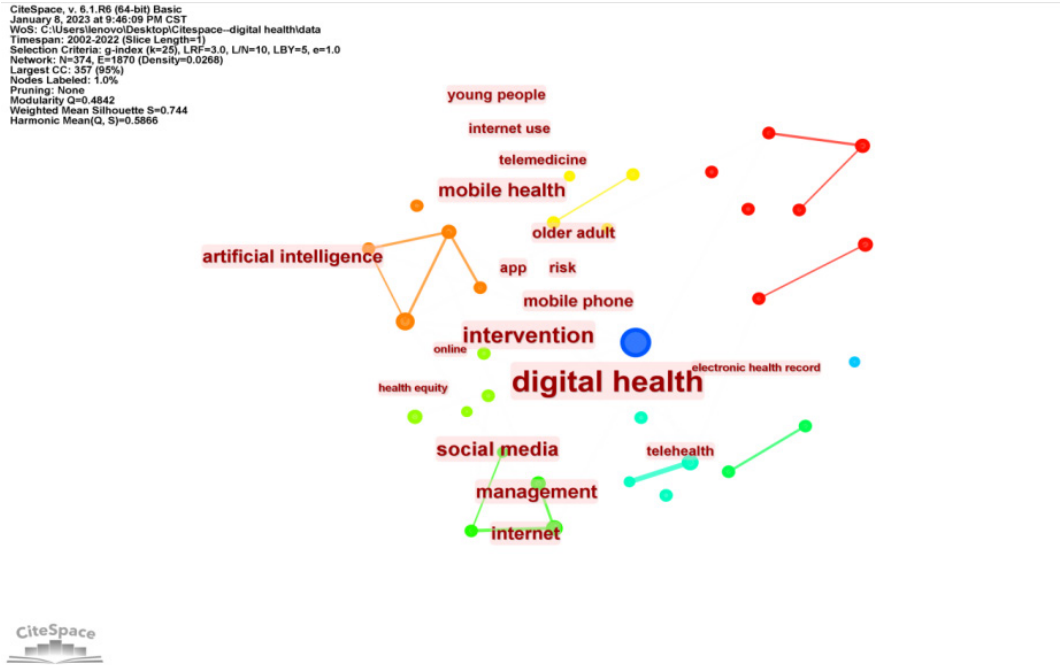

Figure 1. Visual analysis of keywords co-occurrence

The CiteSpace analysis indicates a current scholarly interest in AI, telehealth (telemedicine), and other digital technologies among researchers. Healthcare systems across the globe are struggling with increasing costs and worsening outcomes. In such a context, policymakers, politicians, clinical entrepreneurs, and computer and data scientists increasingly argue that a key part of the solution will be AI (Morley et al., 2020). Telehealth has long held promise for addressing rural health disparities perpetuated by inadequate healthcare access (Kelly et al., 2020). In rural areas, the aging of the population is grievous with a high incidence of disease and illness. Nevertheless, rural regions are confronted with an inequitable distribution of medical resources and the issue of an overall subpar medical standard. Due to this situation, the population in rural areas is beset with the predicament of attaining adequate medical security. The advancement of telehealth has facilitated a more rational allocation of medical resources, and technologies such as AI and 5G can assist the rural population in

accessing significantly superior medical resources, which bear far-reaching benefits for rural health.

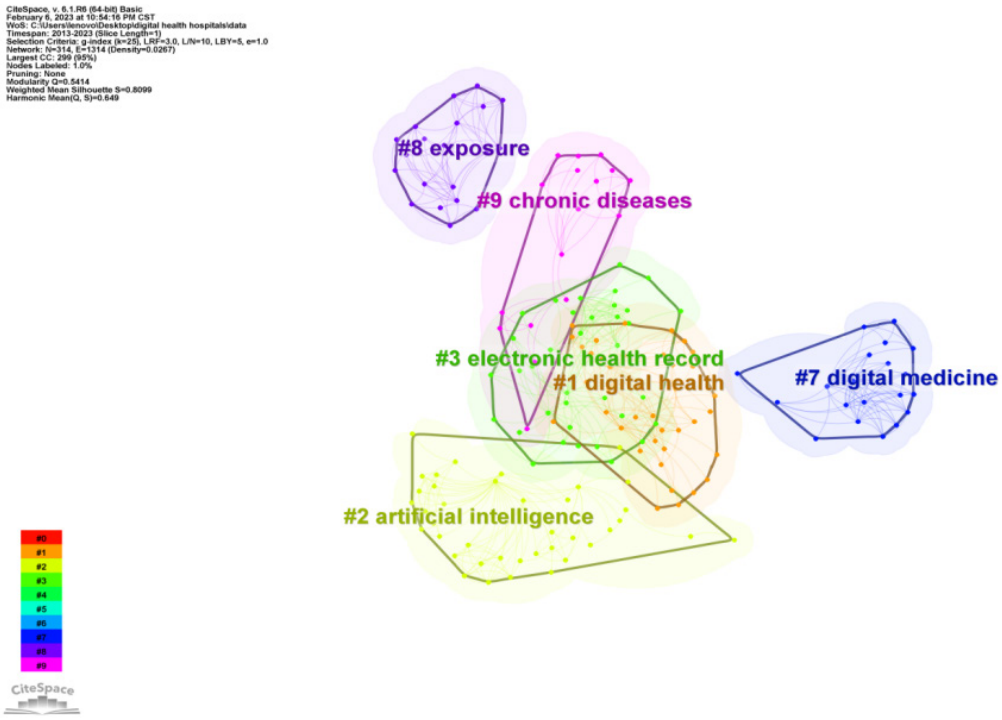

Figure 2. Keywords cluster analysis of digital health and hospital.

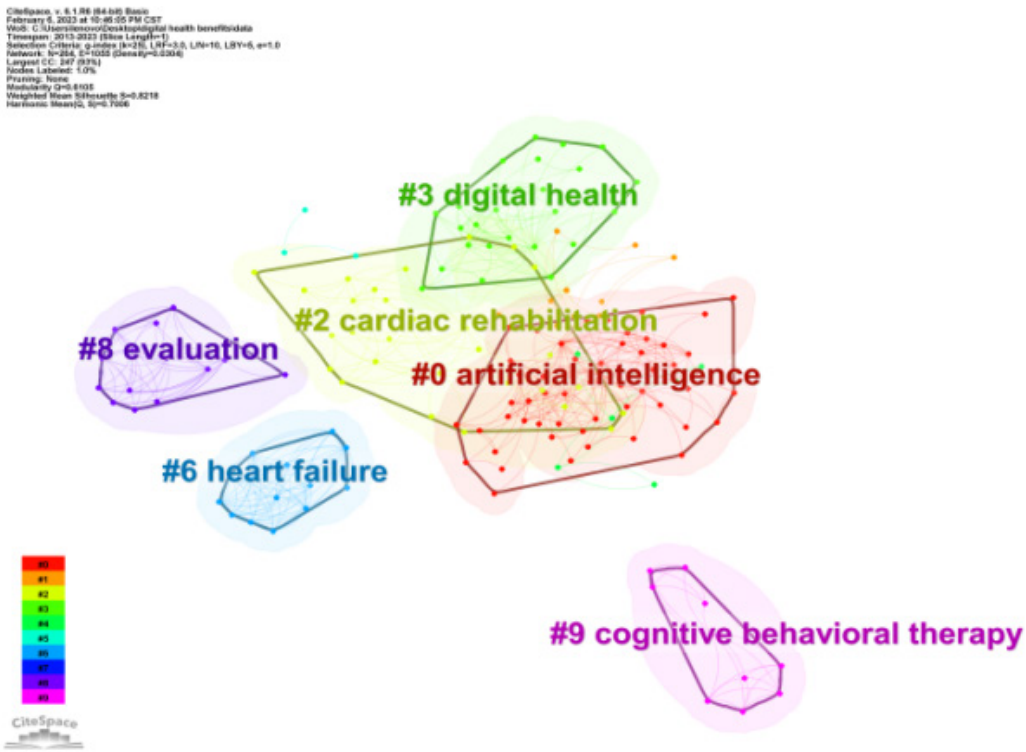

Figure 3. Keywords cluster analysis of digital health and government.

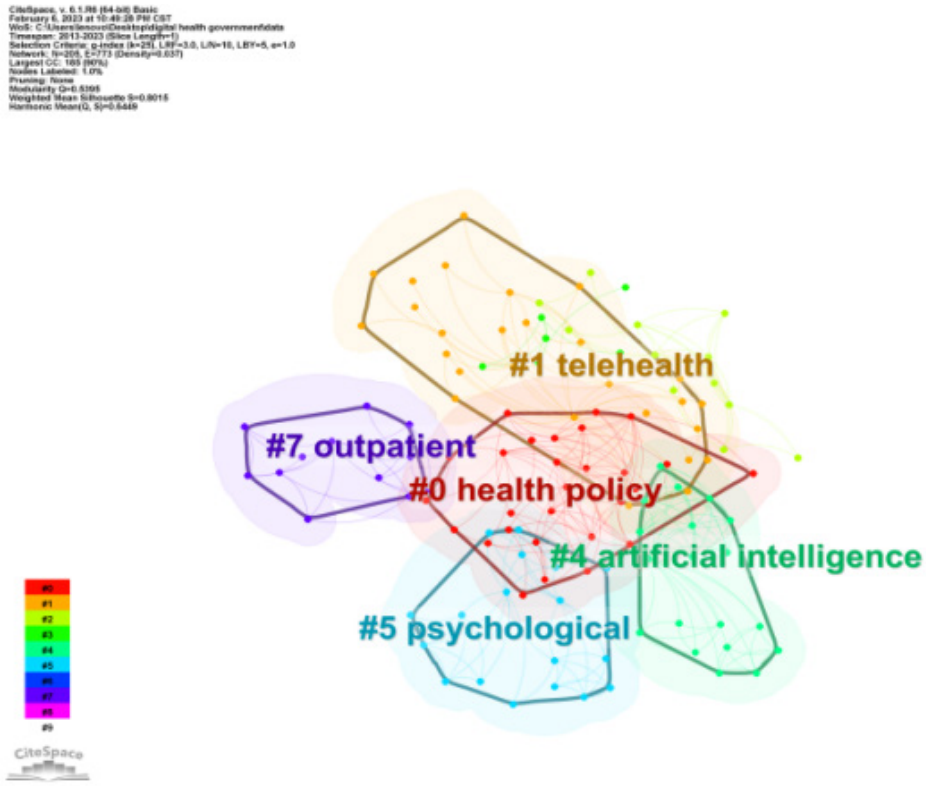

Figure 4. Keywords cluster analysis of digital health and benefits.

In general, via the cluster analysis of the three sets of keywords, namely digital health and hospital, digital health and government, and digital health and benefits, it can be readily identified that the recurrent occurrences of AI and telehealth constitute the research hotspots within the domain of digital health. Specifically, digital health and hospitals are clustered in electronic health records (EHR). The use of EHRs for surveillance has many potential benefits including providing an opportunity to streamline and improve current surveillance practices, improving the reporting of nonlaboratory diagnosed diseases as well as the collection of treatment and risk factor data and enhancing surveillance for chronic diseases (Birkhead et al., 2015). The cluster of digital health and government also focused on health policies and psychology. A research result published in the Lancet stated that their findings are consistent with the idea that greater policy stringency could lead to poorer mental health, which is supported by a range of relevant controls and robustness checks (Aknin et al., 2022). Among the benefits digital health has brought, the multitude especially pays attention to the topic concerned with heart disease such as heart failure and cardiac rehabilitation. For now, implementing best practice care for patients with cardiovascular diseases (CVDs) is one of the greatest challenges for healthcare providers. CVDs require frequent, continuous, and seamless management. Thus, these diseases continue to be important targets for the implementation of digital technologies to enable patients to manage and improve their health through improving quality of care and equity of access, increasing efficiencies, and promoting better patient self-management (Zwack et al., 2023).

4. Current Application Trend of Medtech in Chinese Hospitals

The Chinese University of Hong Kong Hospital exemplifies the successful integration of digital technologies in healthcare. Advanced facilities such as the UNITY - MR Linac and RADIXACT X9 - Tomotherapy systems demonstrate the hospital's commitment to delivering high-quality and efficient medical services. The institution has transitioned to a fully paperless electronic medical record system, leveraging mobile technology

and real-time data to enhance treatment processes. This digital transformation not only optimizes hospital operations but also minimizes errors and lowers operational costs. Moreover, The Chinese University of Hong Kong Hospital implements closed-loop medication Management and an integrated hospital information system to ensure the safety of critical procedures such as prescription, pharmacy review, drug dispensation, patient verification, and medication distribution. To enhance the safety, efficiency, and quality of medication dispensation, the hospital has introduced diverse automated dispensing systems and Internet of Things (IoT) devices (Yu et al., 2022d). Collaborating with bar code management, these systems record medication processes in real time. For instance, the hospital utilizes unit-dose packaging coupled with bar code verification to ensure accurate drug administration timings and dosages for inpatients.

In the context of advancing digital health initiatives, Chinese medical institutions are actively integrating medical technologies into clinical practice. Technologies 3D visualization, 3D printing, imaging omics, virtual reality, and molecular imaging are increasingly being applied in general surgery. These advancements play a crucial role in enhancing the efficiency of disease diagnosis, facilitating the selection of treatment methods, improving surgical success rates, and mitigating surgical risks. These technologies not only invigorate and enhance disease diagnosis and treatment in the field of general surgery but also introduce innovative approaches to surgical development in China.

China has prioritized the development of primary healthcare infrastructure. However, regional disparities in development have led to a 'lock-in' issue within the healthcare system, where resources and patients are increasingly concentrated in large hospitals located in developed urban centers, rather than distributed across primary healthcare facilities (Xu et al., 2019). In recent years, emerging medical technologies have emerged as promising solutions to address healthcare disparities. According to Zhang et al. (2022), telemedicine has rapidly evolved and gained global acceptance as a new model for medical service delivery, facilitated by advancements in telemedicine equipment and information communication technology. Research indicates that telemedicine effectively reduces healthcare inequities, particularly benefiting patients in remote areas (Chunara et al., 2020). China initiated its telemedicine efforts in the late 1980s, with significant expansion noted by 2018 when the telemedicine network encompassed over 3,000 hospitals nationwide. By 2019, nearly all provinces and municipalities in mainland China had established regional telemedicine centers, with the market size reaching approximately USD 2.68 billion. By the end of 2020, the proportion of public medical institutions at or above the secondary level offering telemedicine services had risen from 43.3 percent to 63.2 percent. The telemedicine collaboration network extended to more than 24,000 medical institutions across prefecture-level cities, with 89.5 percent of urban medical groups and county medical communities utilizing internal telemedicine services (Gao et al., 2022). Utilizing this telemedicine network, remote rural patients can access healthcare services provided by top-tier urban hospitals through local county-level medical institutions.

5. Medtech Application and Policies Discussion

Medical technology encompasses the application of advanced network, communication, computer, and digital technologies to enable intelligent acquisition, conversion, storage, transmission, and post-processing of medical information, as well as the digital management of various medical operations. For instance, leveraging big data facilitates the integration of senior and junior medical institutions to optimize the distribution of healthcare resources and enables precise diagnosis and treatment through cognitive computing and related technologies, thereby assisting healthcare providers in enhancing diagnostic efficiency and improving medical service quality (Yu, et al., 2023b). The Internet of Things (IoT) plays a crucial role in facilitating stable, efficient, and structured data collection, serving as foundational support for digital health and a fundamental technological framework for advancing intelligent medical practices (Yu, et al., 2022e). Through wearable devices, IoT facilitates continuous data collection and monitoring, with data analysis performed via big data models. This

process contributes to patient health management and aids physicians in supplementary diagnostic procedures.

In recent years, China's healthcare system has been in full swing, accompanied by rapid development in the medical technology industry within a conducive macroeconomic environment. This industry not only plays a crucial role in disease monitoring, decision-making, and health management but also provides essential technical support for the advancement of modern digital health initiatives, thereby catalyzing sustainable innovation and development in this field. Research conducted by the National Medical Products Administration indicates that from 2001 to 2019, the annual sales of China's medical technology industry exhibited a consistent upward trajectory over the past decade. In 2019, the annual sales of the medtech industry in China amounted to approximately 634 billion yuan and it was estimated that by 2020, the number would be up to 795 billion yuan (Statista, 2023). Currently, the adoption rate of medical technology within the broader medical market remains relatively modest. However, the ongoing integration of emerging technologies, applications, and services is anticipated to expand its share significantly within the medical market.

Table 1. Policies concerned with digital technology in China.

Issuing date	Issuing body	Subject	Main contents	Attitude toward digital health
2015	DOS	Notice on Issuing the Summary of Work in 2014 and Key Tasks in 2015 for Deepening the Reform of Medical and Health System	Accelerate the "Digital Medical Technology Development" project to support medical informatization.	Support
2015	DOS	The Guidance of the State Council on Actively Promoting "Internet+" Action	Accelerate the development of Internet-based medical, health, elderly, and other emerging services	Support
2016	DOS	Guidance on Promoting the Healthy Development of the Pharmaceutica Industry	Accelerate the digitalization of medical equipment, focus on the development of wearable medical devices, and promote the application of new technologies	Support
2018	DOS	Opinions on Promoting the Development of "Internet + Medical Health"	Improve the digital and intelligent manufacturing level of medical and health equipment, and promote industrial upgrading	Support
2020	NDRC	Catalog of Industries to Encourage Foreign Investment(2020 Edition)	Encourage the development and application of products related to digital medical systems, community care, and personal health	Support
2021.3	NMPA	Opinions On Further Promoting the High-Quality Development of Medical Device Standardization	Improving basic standards of medical devices, such as definition of terms, risk management, statistical techniques, and digital safety.	Support
2021.4	MOHURD	Opinions On Accelerating the Development of Digital Home to Improve the Quality Of Living	Form a digital home with orderly developed health, education, entertainment, medical care, fitness, smart broadcasting, and digital home life service systems.	Support
2021.4	CHS	Notice On the Issuance of Guidance On Strengthening Network Security And Data Protection	Clearer process and mechanism of data sharing and improved level of digitization and intelligence of medical security in the future	Support
2021.6	NPC	Outline of the Fourteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China and Vision 2035	Build the 5G-based application and carry out pilot demonstrations in key areas such as intelligent transportation, smart logistics, and smart healthcare.	Support
2021.7	MIIT	Notice On the Issuance of the 5g Application "Sailing" Action Plan (2021-2023)	In the social and livelihood sectors, a number of 5G+smart education, 5G+smart healthcare, and 5G+cultural tourism model projects will be built.	Support

Source: Various Departments

The Chinese government has played a pivotal role in advancing digital health technologies. As detailed in Table 1, a multitude of policies have been enacted to support this development from 2015 to 2021. The government's robust support has significantly contributed to the burgeoning Chinese medical technology sector (Yu et al., 2022g). In 2015, China's leadership set a target for the digital healthcare industry to achieve a 30% increase in output value by 2020. Subsequently, in 2016, China emphasized the importance of integrating cloud computing, big data, the Internet of Things, and other information technologies with health services. The "Administrative Measures for Internet Diagnosis and Treatment," issued in 2018, explicitly encouraged regions to develop Internet hospitals to offer online re-consultation services for common and chronic diseases. With these policies in place, China's digital health sector has emerged as a promising arena. In 2020, the National Healthcare Security Administration issued guidelines to improve the implementation of "Internet +" medical services and medical insurance payments, which have effectively fostered innovation in this sector. Alongside these supportive policies, the Chinese government has also introduced regulatory measures to manage the digital medical market, particularly in medical devices. For instance, in August 2015, the State Council issued the "Opinions on Reforming the Review and Approval System for Drugs and Medical Devices." This was followed in October 2017 by the release of "Opinions on Deepening the Reform of the Review and Approval System and Encouraging the Innovation of Drugs and Medical Devices". These documents outlined further requirements for the reform of medical device registration and the promotion of innovation in drugs and medical devices (Song et al., 2022).

6. Case Studies Discussion

6.1. The University of Hong Kong-Shenzhen Hospital

The University of Hong Kong-Shenzhen Hospital (HKU-SH), established in 2012 and fully supported by the Shenzhen Municipal People's Government, integrates the modern management model of the University of Hong Kong. HKU-SH has prioritized digital transformation and the development of a smart hospital through innovative information technologies. For one thing, this initiative aims to enhance healthcare quality and efficiency, optimize internal medical resource allocation, and improve patient access to healthcare services. For another, the joint hospital can promote the collaboration of Hong Kong and Shenzhen (Yu et al., 2023d).

The University of Hong Kong-Shenzhen Hospital has developed a cross-border pharmaceutical and medical supply chain, linking foreign pharmaceutical manufacturers, operating companies, third-party logistics, and hospital tripartite supply chains. This project ensures timely delivery of medical supplies and implements comprehensive operational management, thus enhancing traceability and availability of clinical supplies in the Greater Bay Area (Yu, et al., 2022c). Additionally, the hospital promotes health data sharing for cross-border medical services, exemplified by the Special Support Treatment Programme for In-patients in collaboration with the Hong Kong Medical Council. Launched in November 2020, this program, supported by integrated medical records sharing, facilitates follow-up treatment and services for Hong Kong patients in Guangdong. Specifically, the program leverages advanced technologies such as big data, the Internet of Things, cloud computing, and 5G communication to implement fully voice-driven operation robots in smart wards and establish a unified data storage platform within the hospital's existing information system.

Apart from this, HKU Shenzhen Hospital has also demonstrated exceptional clinical achievements. Notably, it has pioneered non-fusion VBT minimally invasive surgery for scoliosis in Mainland China. This technique, compared to traditional fusion surgery, offers faster recovery and preserves spinal movement by leveraging the patient's natural growth process post-surgery for gradual correction of scoliosis. This advancement represents a significant breakthrough in scoliosis treatment. Additionally, the hospital has successfully performed thoracoscopically assisted sutureless aortic valve implantation, offering advantages such as minimal

trauma, cost-effectiveness, and the absence of sutures. This novel surgery marks a milestone in sutureless valve technology and promises broader benefits for patients.

6.2. Peking Union Medical College Hospital (PUMCH)

Peking Union Medical College Hospital (PUMCH) serves as the clinical arm of Peking Union Medical College (PUMC) and is recognized as China's premier general hospital renowned for its exceptional achievements in medicine, education, and research. Peking Union Medical College Hospital (PUMCH) has spearheaded the development of a treatment system for pelvic floor dysfunction in women. In 2020, PUMCH conducted China's first national epidemiological survey on urinary incontinence and lower urinary tract symptoms, identifying key causes and risks. Their research supports the "hammock" hypothesis, underpinning clinical treatments and surgical precision. The "Union pelvic floor reconstruction" designed by PUMCH achieves a 90 - 95% cure rate for severe uterine prolapse, comparable to global standards, and has been widely adopted across 100+ Chinese hospitals, reducing medical costs significantly. This is the first project integrating bio-3D printing into pelvic floor reconstruction, benefiting millions of women. These initiatives represent leading efforts in China and contribute substantially to global advancements in pelvic floor disorder management.

Since 2020, the ophthalmology department at Peking Union Medical College Hospital has leveraged the Peking Union Medical College Hospital Telemedicine Centre to pioneer 5G telemedicine services. This advancement has facilitated remote laser treatments for nearly 20 patients located up to 4,000 km away, demonstrating the capability of real-time medical intervention through digital technology. 5G telemedicine addresses the homogeneity of medical treatment by enabling specialists from large hospitals to provide direct care to patients in rural areas (Kwok et al., 2024a). Additionally, it enhances the capacity of primary hospitals by involving local doctors in the treatment process under remote guidance. Specifically, these operations are recorded for educational purposes. These recordings not only promote knowledge exchange and skill enhancement but also aim to elevate the overall standard of medical practice across primary healthcare facilities through continuous learning and professional development.

In the future, Peking Union Medical College Hospital will continue to enhance its Internet-based medical services and further develop a collaborative telemedicine network. The hospital aims to extend high-quality medical resources to remote areas, with the ultimate goal of significantly improving the health and well-being of a broader population (Kwok et al., 2024b).

6.3. Ruijing Hospital

Ruijing Hospital is the fourth largest general hospital in China and is a model and leader of hospitals in Eastern China. On December 29, 2022, The New England Journal of Medicine (NEJM), a prominent medical journal, published a study comparing the oral nucleoside antiviral drug VV116 (JT001) to the combination of Nirmatrelvir/Ritonavir (PAXLOVID) for early treatment of patients with mild to moderate COVID-19, including those at high risk of severe progression or death (NCT05341609). Conducted at Ruijin Hospital of Shanghai Jiaotong University, this phase III clinical trial represents the first of its kind for a small molecule oral antiviral in Chinese COVID-19 patients during the Omicron variant epidemic. The study demonstrated that early administration of oral VV116 was non-inferior to nirmatrelvir–ritonavir in reducing time to sustained clinical recovery among participants with mild-to-moderate COVID-19 at high risk of severe disease. Importantly, VV116 exhibited a favorable safety profile compared to Nirmatrelvir–Ritonavir (Cao et al., 2022). These findings contribute valuable data and insights to the global development and clinical application of small-molecule antiviral drugs against COVID-19, enhancing efforts to combat the pandemic both in China and internationally.

In early 2022, Ruijin Hospital's Department of Nephrology became the first to introduce the Ekodextrin peritoneal dialysis solution in mainland China. This innovative approach diversifies abdominal dialysis

treatments and breaks the limitations of traditional glucose solutions. Ekodextrin's high molecular weight enhances dialysis efficiency with extended abdominal retention time of up to 16 hours, reducing cardiovascular risks and mortality for end-stage renal disease patients. Meanwhile, Ruijin Hospital is a pioneer in peritoneal dialysis in China as well. The hospital's Blood Purification Center specializes in abdominal dialysis, with over 500 long-term patients achieving a 3-year survival rate exceeding 80%, low peritonitis incidence (0.1 per patient-year), a 6.2% dropout rate, and an average treatment duration of 76 months. Ruijin Hospital has established Shanghai's first peritoneal dialysis care protocols and expanded these practices across the Yangtze River Delta region.

6.4. Shehong First People's Hospital

In China, the demand for medical services is steadily increasing, yet there remains an uneven distribution of medical resources, especially at the county level. Shehong City, situated in the economically disadvantaged Sichuan Basin, has historically faced challenges in developing its county-level hospitals. Previously, township health centers and outpatient clinics in Shehong could only provide basic examinations, thus necessitating travel to central county hospitals for specialized care due to limited medical technology and staff.

Advancements in information technology and transportation, coupled with the promotion of medical association models, have transformed Shehong First People's Hospital. It has established a medical testing center connected to various healthcare institutions, enabling local residents to undergo diagnostic tests without extra travel (Popescu & Yu, 2023). Currently, the hospital operates two blood transfer buses daily, servicing over 1,000 medical facilities across 21 towns and villages. These buses collect blood samples for centralized testing at the Shehong Regional Medical Testing Centre. However, the increasing volume and variety of tests conducted at the Shehong Regional Medical Testing Centre have surpassed its current capacity, presenting a new challenge for the facility.

In this regard, the integration of digital technology into medical testing centers to digitize medical tests has proven to be an effective solution (Yu & Xu, 2022). The implementation of Mindray's intelligent assembly line has addressed the challenges faced by these centers. This technology has reduced staffing requirements while increasing the daily testing capacity by 1.8 times, significantly enhancing testing efficiency. Advanced digital technology improves medical standards in remote areas, thus not only reducing disparities between Tier 4 and Tier 5 cities and Tier 1 cities but also fostering greater medical excellence and social equity throughout China.

6.5. The First People's Hospital of Bijie

The First People's Hospital of Bijie is the only Class A general hospital in Bijie; however, its medical level is still significantly lower compared to those in first-tier cities. In order to narrow down the gap, Peking Union Medical College Hospital, renowned as a model institution within the Chinese medical community, has been designated to support and enhance the orthopedics department at the First People's Hospital of Bijie.

Since this collaboration began, experts from Peking Union Medical College Hospital, including doctors, physicians, and nurses, have conducted lectures and training sessions for their counterparts at the First People's Hospital of Bijie. These efforts have been aimed at disseminating advanced medical knowledge, sharing valuable clinical experience, and elevating the capacity of Bijie's medical staff. Additionally, Xiehe Hospital has been actively involved in providing guidance on complex cases and conducting educational visits.

This project aligns with the China Western Development Strategy and facilitates communication and advancement in the medical field. The academic exchanges have positively contributed to the standardization of medical treatment and bridged the medical gap between less developed regions and major cities.

Table 2. Leading medical enterprises and representative technologies.

Firm	Representative scientific and technological innovation products
Surgnova Healthcare Technologies	·Endoscopy Platform ·TumorAblation Platform ·Energy Surgery & Surgical Stapling Platform
MGI	·Genetic Sequencers ·Single-cell Platform ·Ultrasound Platform
Unionstrongtech	·USearch: Cerebrovascular health check-up platform ·UGuard: Cerebrovascular imaging with AI ·UKnow: Integrated intelligent assistance for prevention, screening, diagnosis, treatment, follow-up/dynamic monitoring
Raysightmed	·RuiXin--FFR: The highest accuracy CT-FFR products and the world's first "Morphology" and "Functionality" Integrated CT-FFR products ·Ruixin Coronary AI: The world's most complete and complete coronary CTA image intelligent analysis product ·RuiXin Vascular Robot: Protect doctors from radiation and immediate visual feedback
LongwoodValley Medtech	·AIHIP artificial intelligence hip replacement system ·AIKNEE artificial intelligence knee replacement system ·ROPAplasty artificial intelligence hip replacement surgical robot system
TmiRob	·Intelligent Disinfection Robot ·Intelligent Distribution Robot ·Nuclear medicine ward service robot
Gaush	·LS-313 MF30T Tai Liang area refractive multifocal astigmatism aspheric intraocular lens ·RM-800 contrast sensitivity instrument ·AMARIS 1050RS excimer laser corneal refractive therapy machine
Ariemedi	·Navigation robot system for skull base surgery ·Augmented reality visualization system ·Surgical simulation system

Source: Authors

Table 2 illustrates that Chinese medical enterprises have made remarkable achievements and taken the lead in global medical technologies. These attainments have not only enhanced domestic healthcare standards but also provided valuable experience for the development of global medical technology. Breakthroughs in areas such as digital health and AI not only help bridge the gap between urban and rural healthcare levels within China but also offer support for the development of healthcare sectors in other countries and regions.

7. Emerging Medical Technology Helps to Solve the Gap Between Developed and Underdeveloped Regions in China from Health Resources Administration Perspective

Superior healthcare services can provide a solid foundation for national competitiveness and societal soundness. However, the current traditional healthcare service system is inherently affected by geographical limits and uneven distribution of healthcare resources, which are relatively powerless to respond to unusual events, such as unpredictable public health crises (Y. Chen et al., 2022). Generally, medical resources include personnel, medical expenditures, medical devices, medical establishment, knowledge and skill. Nowadays, rural hospital systems are managing chronic disease burden in an aging population with already limited access to healthcare providers (Hirko et al., 2020). With an aging population in China, the demand for medical resources is escalating, particularly in rural areas. However, the economic disparity between urban and rural regions complicates the equitable distribution of medical resources, resulting in significant regional disparities and pronounced polarization. Rural residents often face substantial challenges in accessing medical care. Recent

advancements in medical technology present a promising opportunity to achieve a more equitable distribution of healthcare resources between urban and rural areas.

AI technologies, such as virtual AI and telemedical technology, are expected to overcome the current limitations of the distribution of medical resources and relieve the pressure associated with obtaining high-quality healthcare (Li et al., 2020). As an important part of the information technology system, blockchain technology is characterized by decentralization and non-tampering (Yu et al., 2022b). It can realize the sharing of medical resources through a mechanism of resource storage, circulation, supervision, and protection. The construction of a medical resource-sharing mechanism under the condition of blockchain technology will greatly improve the degree of medical resource sharing, will narrow the differences in resource allocation between regions, and effectively respond to an outbreak of major public health emergencies (Liu & Liu, 2021).

In China, medical technology companies are experiencing rapid development with support from the government. A diverse range of medical devices utilizing advanced technologies such as AI, 5G, and blockchain have been introduced, enhancing access to medical resources and services in remote areas (Yu et al., 2023e). For instance, Peking Union Medical College Hospital (PUMCH) has successfully conducted remote surgeries for 20 patients located thousands of kilometers away using advanced telemedicine equipment. This program effectively utilizes cutting-edge medical methods and significantly helps bridge the gap in medical resources between urban and rural areas. Additionally, in Shehong, Sichuan Province, the local government, in collaboration with the medical technology company Mindray, has established an independent medical testing center equipped with state-of-the-art testing technologies. This development not only improves the convenience and efficiency of medical testing for local residents but also reduces testing costs.

The advancement of medical technology has significantly enhanced the utilization efficiency of advanced medical resources (Yu et al., 2022f). For primary hospitals in underdeveloped areas, telemedicine offers substantial support through various remote services, including remote consultation, remote monitoring, and remote surgery. For instance, remote consultations with authoritative experts can provide primary care physicians with more precise and detailed patient assessments, thereby facilitating more targeted and comprehensive treatment plans. This capability not only improves diagnostic and therapeutic accuracy but also ensures that patients will receive high-quality care despite geographic limitations.

Through remote surgery, surgeons can extend their arms thousands of miles away, which greatly expands the operating space of doctors. Consequently, high-quality medical resources can sink to rural areas, thus narrowing the gap between medical systems and reducing the economic burden of patients. Moreover, online drug platforms can better mitigate the problems facing hospitals in rural areas, such as being short of rare drugs and overdependent on superior hospitals. In addition, remote medical education is also an indispensable part of the process of promoting the even distribution of medical resources. Through distance learning, interactive lessons between senior specialists and primary doctors could be realized, imparting advanced medical knowledge and medical experience to enhance the capacity of primary doctors.

In the context of severe imbalanced development among regions in China, medical resources are always skewed towards big cities such as Beijing and Shanghai. Now, emerging medical technology, to a large extent, can help address part of the problem. Telemedicine, as a crucial part of digital health, contributes a lot to the goal of realizing the even distribution of medical resources to narrow the gap between developed and underdeveloped regions in China.

8. Conclusion & Recommendation

In conclusion, digital health is gaining more and more attention around the globe. China, as the second largest economy in the world, has made remarkable achievements in the development of digital health and telemedicine is one of the hot spots. Meanwhile, A number of policies have been issued from 2015 to 2021 by

the government to support the development of digital health. While hospitals in big cities such as The University of Hong Kong-Shenzhen Hospital, Peking Union Medical College Hospital (PUMCH), and Ruijing Hospital improve their own level through emerging medical technologies, they can also share abundant medical resources with other medical institutions, driving the development of lower-level hospitals. County-level hospitals such as Shehong First People's Hospital and The First People's Hospital of Bijie also benefit a lot from advanced medical technologies. Remote consultation, remote surgery, and many other forms of telemedicine permit patients to access a greater amount of medical resources. AI, blockchain and 5G integrated with healthcare can not only enhance the medical service level but can also have tremendous potential to promote the effectiveness of resource administration in the healthcare system, narrowing the gap between urban and rural areas and improving the quality of healthcare system.

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