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China Smart Healthcare Industry Whitepaper

Contents

1. Background of the Smart Healthcare Industry

As intelligent technologies are rapidly advancing and being deployed at scale, smart transformation has become one of the hottest areas of investment and development across industries. In China's life sciences and health care industry, smart healthcare is gaining momentum. As an upgrade to traditional healthcare informatization, smart healthcare integrates new-generation information technologies such as 5G, cloud computing, big data, and artificial intelligence, driving a paradigm shift toward intelligent systems.

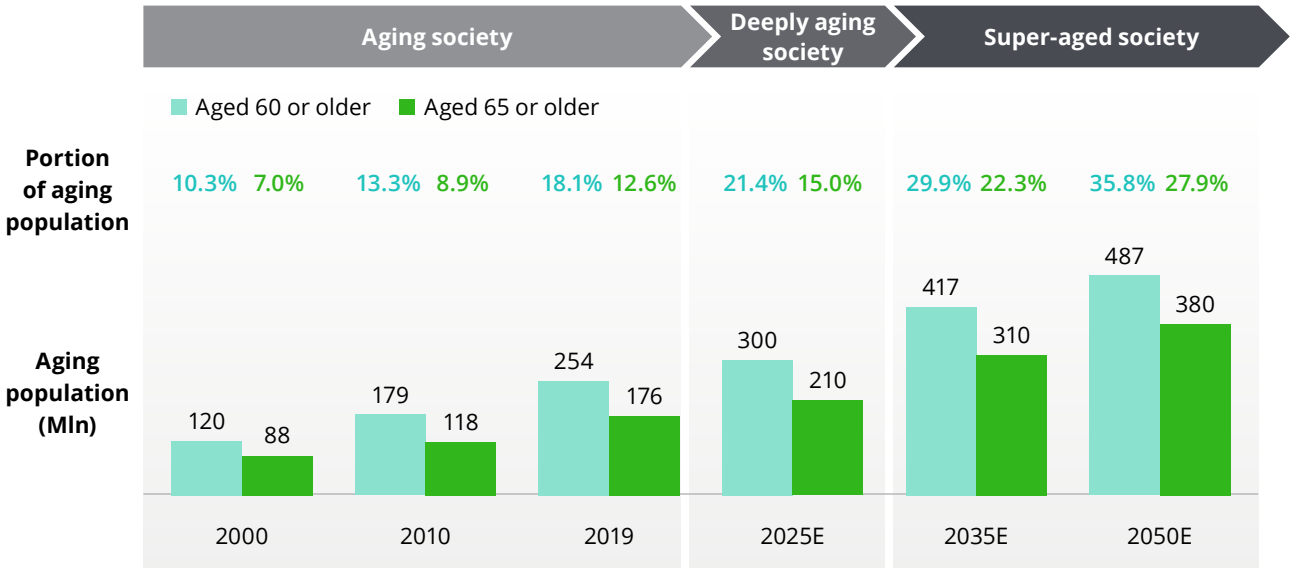
The motivation to develop smart healthcare stems from several macro-level factors. First and foremost, smart healthcare is expected to help address the long-standing imbalance in the distribution of medical resources across China. According to data published by the National Health Commission, in 2023, tertiary hospitals make up only 10% of all hospitals nationwide but handled 62% of outpatient visits. The outpatient volume at tertiary hospitals has continued to grow over the past decade, increased 15% from 2014, while that at secondary and lower-level hospitals has steadily declined, falling from 45.1% in 2014 to 34.5%[1] in 2023. This clearly demonstrates the issue of uneven distribution of medical resources.

Second, with the continuous improvement of living standards, the public has increasingly higher expectations for the quality, efficiency, and experience of healthcare services. People are pursuing a more personalized and proactive approach to health management. As public health awareness rises, attention has gradually shifted from "disease treatment" to "disease prevention", accompanied by the emergence of a growing consciousness around self-health management.

[1] Statistical Communiqué of the People's Republic of China on the 2023 National Medical and Healthcare Development, NHC, August 2024

Finally, changes in population structure have also generated many new medical demands. The accelerating aging of the population, for example, has led to increased demand for chronic disease management and rehabilitative care. According to United Nations standards, China officially entered the category of a deeply aging society in 2022 and is expected to become a super-aged society by 2035. The challenges posed by an aging population and declining birth rates have led to new medical needs, and requiring new disease management models and new long-term care paradigms. Traditional single-mode healthcare model is no longer sufficient to meet the evolving healthcare demands of a transforming population structure.

Figure 1: The path of aging population in China



Note: the classification of aging society stage is from 1956 United Nations Classification Criteria

Source: China Development Report 2020: Trends and Policies on China's Aging Population, National Bureau of Statistics, Deloitte Research

With that, smart healthcare, featuring convenience, efficiency, and precision, has developed rapidly. It enhances the efficiency of the entire healthcare value chain while offering more diverse choices for medical services. At present, the growth of smart healthcare is being supported by favorable policies, funding support, emerging clinical demands, and advanced technologies.

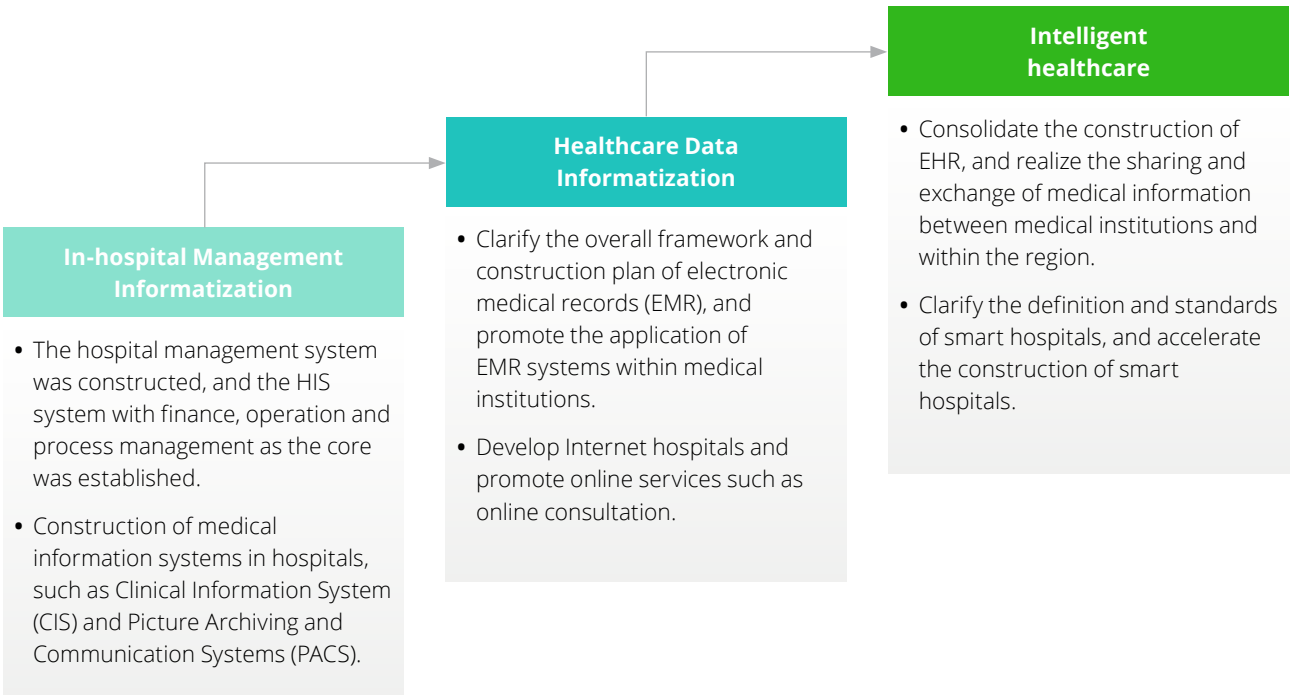
1.1 Policy as the core driving force of smart healthcare

To achieve more accessible and equitable healthcare services, China has introduced multiple stages of policy initiatives to advance the transformation of healthcare informatization. Based on government policies introduced during various periods, the development of smart healthcare in China can be divided into three phases, from in-hospital management informatization to healthcare data informatization, and now to smart healthcare.

- **In-hospital Management Informatization phase**: This phase focused on the construction of Hospital Information Systems (HIS) to fulfill the basic need for informatization of internal operational processes. During this period, the Ministry of Health released the *Basic Functional Specifications for Hospital Information Systems (Second Edition)* and the *National Health Informatization Development Plan Outline (2003–2010)*, which provided clear standards and guidance for HIS construction.

- **Healthcare Data Informatization phase**: This phase marked the beginning of implementing electronic medical record (EMR) systems within medical institutions. Policies such as the *Basic Framework and Data Standards for Electronic Medical Records (Trial)*, the *Functional Specification for EMR Systems*, and the *Grading Standards for EMR System Functionality and Application* promoted the overall development of healthcare informatization. A new format of internet hospitals also emerged, extending medical services from offline to online channels.
- **Intelligent Healthcare phase**: Policies like *Further Promotion of EMR-Centered Informatization in Medical Institutions* and the *Interoperability Maturity Evaluation Plan for National Health Information (2020 Edition)* deepened the construction of healthcare informatization and accelerated regional interoperability of medical information. In addition, the National Health Commission officially proposed the concept of "smart hospitals" in 2019 and gradually refined its standards.

Figure 2: China's healthcare system is gradually evolving towards smart healthcare



Source: Desktop research, Deloitte Research

Furthermore, the government has paid increasing attention to using digital tools to address sudden public health emergencies. A series of guiding policies have been introduced in recent years. For example, the "Guidelines on Building a Smart, Multi-Point Infectious Disease Monitoring and Early Warning System," issued in 2024, plans to establish a complete monitoring system for infectious diseases and other public health events by 2030. The system will leverage artificial intelligence, big data, cloud services, and intelligent devices to enhance monitoring, real-time analysis, and centralized decision-making for abnormal health events, achieving faster and more accurate early warnings.

Under this national top-level strategic framework, local governments have actively responded and issued innovative regional policies and pilot projects based on local realities. At the regional level, the overall smart healthcare development shows a stepped pattern. Coastal and first-tier cities, where with abundant internet technology companies and life sciences enterprises, have generally more active development. Central and western regions are also ramping up support for smart healthcare year by year, yet the overall development pace is slower compared to coastal and first-tier city areas due to lower penetration rates of smart technologies and uneven distribution of medical resources.

Currently, the development model of smart healthcare in various provinces and cities is characterized by "government-led, multi-party cooperation," where government departments issue policy frameworks, and enterprises, hospitals, and research institutions collaborate based on their respective strengths. Looking across the nation, the Yangtze River Delta region has seen faster development of smart healthcare, with a focus on full-chain digital transformation and intelligent information upgrades. In contrast, Beijing and Shenzhen are more focused on the integration of "AI + healthcare scenarios."

In June 2021, the Shanghai Health Commission released the *Digital Transformation Work Plan for Convenient Medical Services*, promoting digital upgrades at the municipal level. In 2022, Renji Hospital in Shanghai took the lead in using Tencent's medical AI model to expand the scope of smart customer service in its internet hospital, guiding patients through the entire process of registration, consultation, payment, reimbursement, report access, and medication logistics, thereby optimizing the patient journey.

In June 2021, the Zhejiang Provincial Development and Reform Commission issued the *14th Five-Year Plan for Medical Service System and Medical Institution Planning*, aimed at building a smart and interconnected health service and regulatory system. In the same year, the "Future Hospital" information system co-developed by Alibaba Health and Xiniu Medical went live at the First Affiliated Hospital of Zhejiang University. Since then, all four clinical campuses under the hospital have migrated their core information systems to the cloud, breaking down inter-campus information silos, unifying patient records, and enabling the sharing of EMR data. This has improved diagnostic efficiency and enabled more flexible allocation of medical resources across campuses.

In August 2022, the Jiangsu Provincial Health Commission announced the construction of a provincial imaging platform in cooperation with the National Healthcare Security Administration's Big Data Center. The "Imaging Cloud" platform launched in 2022 enables mutual recognition of imaging results within the province. Doctors and patients can access these results anytime. By 2024, Jiangsu launched a "Clinical Laboratory Cloud" platform covering 178 mutual recognition items. By September 2025, nearly 2,000 public medical institutions in the province, including primary healthcare facilities, are expected to be connected.

In May 2024, the Beijing Municipal Government released the *Action Plan for Coordinated Innovation in Medicine and Health (2024–2026)*, explicitly supporting the development and application of large medical models. By 2025, the Beijing Children's Hospital, Baichuan Intelligent, and Xiaoerfang Health Technology will jointly create an "AI Pediatrician," integrating clinical experience from over 300 renowned pediatric experts and decades of medical records to enable multidisciplinary consultations. Meanwhile, Peking Union Medical College Hospital and the Institute of Automation of the Chinese Academy of Sciences are jointly developing the "Concord-Taichu" rare disease model, now officially in clinical use. It is the world's first rare disease model tailored to the Chinese population.

In March 2025, the Shenzhen Municipal Industry and Information Technology Bureau released the *Action Plan for Building an AI Pioneer City (2025–2026)*, promoting smart diagnosis and treatment, smart health management, smart public health management, and medical robotics in healthcare. The world's first critical care large AI model, co-developed by Mindray Medical and Tencent, was deployed at Peking University Shenzhen Hospital. This AI system allows doctors to review and integrate case information in 5 seconds and write a medical record in just 1 minute, acting as an intelligent medical encyclopedia for intensive care.

1.2 The rapid advancement of corporate compliance requirements in smart healthcare

The rapid development of smart healthcare has brought about various challenges in data management and regulatory compliance. In recent years, China has introduced several laws and regulations to increase compliance expectations for pharmaceutical and medical device companies. These expectations span the entire product lifecycle, from R&D and production to marketing and distribution, and include requirements around quality control, data security, and privacy protection.

The pharmaceutical and medical device industries are now facing unprecedented regulatory pressure. For instance, the 2019 revision of the *Drug Administration Law* introduced full-chain compliance obligations for drug development, manufacturing, and post-market supervision. The revised law emphasizes GMP (Good Manufacturing Practice) and GSP (Good Supply Practice) compliance, directly linking adherence to regulatory standards with licensing for manufacturing and distribution.

Furthermore, the law imposes requirements on the online sale of prescription drugs, mandating that e-commerce platforms verify prescription authenticity and ensure patient safety. Additional policies, such as the *Measures for the Supervision and Administration of Drug Operation and Use Quality*, the *Compliance Guidelines for Pharmaceutical Enterprises to Prevent Commercial Bribery Risks*, and *Opinions on Deepening Reform of Pharmaceutical and Medical Device Regulation*, signal that China will continue to raise the bar for oversight in these sectors.

Given this evolving landscape, pharmaceutical and medical device enterprises must urgently build or upgrade comprehensive compliance management systems. Increasingly, digital solutions are being adopted to address regulatory challenges. For example, our Deloitte China team has introduced the D-GSP platform for pharmaceutical and medical device quality management, which helps companies in mainland China prepare for GSP inspections and improve business operations. The D-GSP platform enables full-process management, quality monitoring, documentation, and risk warnings. This strengthens a company's compliance capabilities and supports its digital transformation.

With standardized and structured data control, pharmaceutical business processes become up to 80% more traceable and controllable, ensuring compliance throughout storage, transport, and other stages. Business continuity and operational stability improve by about 40%, while quality and safety across all steps are significantly enhanced. In fact, the incidence of compliance risk events can be reduced by as much as 90%.

As smart healthcare advances, protecting health data and patient privacy is becoming increasingly important. Technological innovation is giving rise to new business models and applications, expanding the flow and use of personal health data, including patient information, test results, and medication records. To support industry standardization, the government has issued data protection regulations tailored to healthcare.

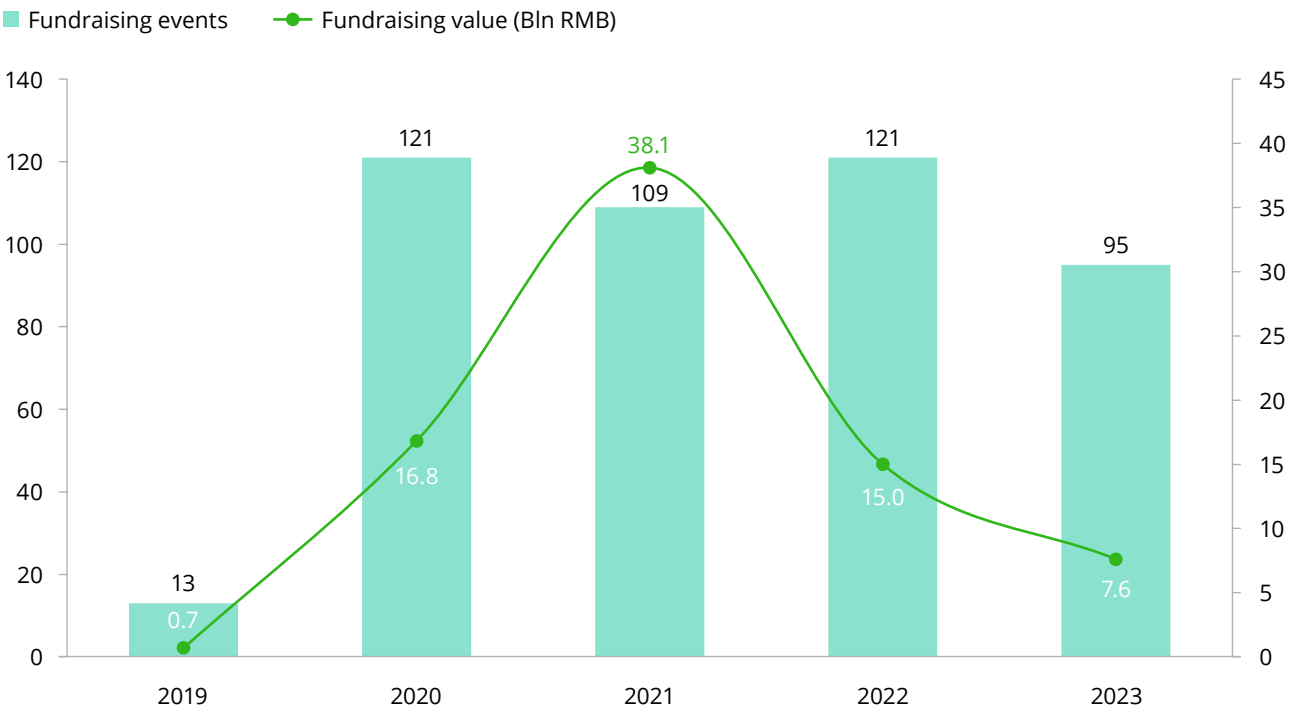
In 2021, China released the Information Security Technology Guidelines for Health and Medical Data Security. These guidelines clearly define "health and medical data" (limited to electronic data) and include requirements regarding data attributes, usage, disclosure security, and business operations. Regulatory authorities will use the guidelines to strengthen supervision and assessments. Healthcare providers, third-party service firms, and other stakeholders must ensure data risks are controllable.

1.3 Fundraising enthusiasm in the smart healthcare remains high, with a shifting appetite to projects that demonstrate long-term commercialization capabilities

Thanks to strong government backing, investor interest in smart healthcare has grown considerably. Since 2019, the sector's investment and financing activities have expanded rapidly. In 2019 alone, there were 13 fundraising deals in China's smart healthcare space, with total funding of approximately 700 million RMB. By 2021, the number of fundraising deals rose to 121, and total funding exceeded 10 billion RMB, a multi-fold increase in just three years.

However, due to macroeconomic headwinds, a valuation correction phase, and intensified anti-corruption campaigns in health care industry, the pace of fundraising events has slowed since 2022, becoming more apparent in 2023. In 2023, there were 95 fundraising events, raising 7.6 billion RMB. As a result, investors have become more cautious, focusing on project compliance and long-term value. Mature enterprises and proven business models are now more attractive, particularly in fields with successful AI applications like medical imaging. Although the growth rate has declined, the industry is not stagnating. Rather, smart healthcare has entered a new phase that emphasizes project quality and commercial viability. Sustainability is becoming a priority.

Figure 3: the fundraising events of smart healthcare from 2019 to 2023



Source: InnoHere, Deloitte Research

From a business perspective, AI healthcare is the most heavily funded segment within smart healthcare. Between 2017 and 2023, investment activity in this space fluctuated. The number of annual deals rose from 58 in 2017 to 93 in 2021, then dropped to 29 in 2023[2]. This reflects a same shift as in the smart healthcare industry. Investors are becoming more rational, paying closer attention to the practical application and large-scale promotion of smart technologies in medical settings.

Popular investment areas include AI drug discovery, diagnostics, medical devices, and holistic solutions. Investors are still supporting startups and early-stage ventures, with capital being distributed fairly evenly across funding rounds.

Some internet giants are also increasing their investment in emerging companies with the potential for technological breakthroughs, aiming to accelerate the strategic layout in the smart healthcare market. For example, in October 2024, Tencent invested USD 30 million (approximately RMB 210 million) in Insighta, an early cancer detection company based in Hong Kong, to support Insighta's acceleration of clinical trials and commercialization processes. Insighta's early cancer detection platform uses its proprietary FRAGMA technology, which can achieve non-invasive and high-precision detection of multiple types of cancer at an early stage. This technology has already initiated clinical trials for liver cancer in mainland China and plans to expand to lung cancer detection soon. In addition to financial support, Tencent also leverages its expertise in AI to further enhance the accuracy of FRAGMA technology in early cancer detection, reduce testing costs, and promote the widespread application of FRAGMA technology in the early screening of various cancers.

At the same time, several emerging smart healthcare companies have also successfully gone public in recent years, covering areas such as internet healthcare, AI healthcare, and health management.

- The digital health care service platform HealthWay has been listed on the Hong Kong Stock Exchange, raising a total of HKD 200 million. HealthWay has established a comprehensive online health service system covering health support, diagnosis and treatment, as well as rehabilitation tracking throughout the entire cycle of health care services.
- iFLYTEK Medical, a provider of AI healthcare solutions, listed in Hong Kong, becoming the first stock in the Hong Kong market for large medical models, raising approximately HKD 580 million. As the domestic manufacturer with the widest coverage of AI+ healthcare, iFLYTEK Medical offers a variety of healthcare products and services, including medical large model solutions, auxiliary diagnostic and therapeutic products for primary and grade hospitals, post-diagnosis and chronic disease management services, as well as hardware and software products directly targeting residents.
- Smart healthcare solutions provider WeDoctor has submitted a prospectus to the Hong Kong Stock Exchange, aiming to raise between USD 400 million and 500 million (approximately HKD 3.12 billion to 3.90 billion). WeDoctor has independently developed an industry-leading healthcare-specific large model, promoting the development of health communities through the application of intelligent technologies, providing cost-effective medical health management services.

[2] "启示2024：中国AI医疗行业投融资及兼并重组分析", Qianzhan Research

1.4 New healthcare demands accelerate the rapid iterative development of smart healthcare

Driven by population structure changes and increased health awareness, people's medical service needs have evolved toward more personalized and intelligent services, further accelerating the development of smart healthcare.

On one hand, China's aging population is deepening. By the end of 2023, the elderly population aged 60 and above had reached 296.97 million, accounting for 21.1% of the total population, officially marking China as an aging society. New models of eldercare, such as community and home-based care, are rapidly emerging. Related healthcare service demands are also growing rapidly, focusing on daily health monitoring, medical consultation, and health education. A variety of smart devices and platforms are becoming common in households and communities, including smart nursing robots, real-time doctors-patients communication platforms, and smart monitoring terminals.

On the other hand, the state's continued promotion of shifting from disease treatment to disease prevention has led residents to pay more attention to personal health management and chronic disease control. Especially in the post-pandemic era, people are more willing to learn health knowledge and engage in health management. This shift is reflected in the national health literacy index, which tracks Chinese citizens' ability to obtain, understand, and apply health information.

According to data from the National Health Commission, the national health literacy level increased from less than 10% in 2014 to 30% in 2023, multiple growth over the past decade. This improvement is closely related to the deep penetration of smart healthcare, which has broken the "information island" dilemma of traditional healthcare systems and enabled more efficient dissemination of medical knowledge.

In the digital age, short video platforms have become a major source for people to obtain various information, including health-related knowledge. With the rapid development of smart healthcare, many healthcare professionals are using their expertise and clinical experience to produce easy-to-understand short video content that translates complex medical knowledge into digestible health tips. These videos cover a wide range of topics, such as medication guidance, healthcare stories, and everyday science education, with the latter two being the most popular.

In China, obtaining health knowledge through short videos has become common. This content significantly reduces the information gap between doctors and patients, especially benefiting those living in areas with limited access to medical resources.

For instance, on the Douyin platform, which boasts a vast user base, high-speed dissemination and diverse formats, health education videos have become a new hub for medical science learning. According to data published by Douyin Health, from August 2023 to August 2024, Douyin saw the addition of 13,000 healthcare related content creators and 3.7 million new science videos covering topics like disease prevention, treatment, healthy lifestyles, and first aid. These videos received 1.31 billion saves, 3 billion likes, and 1.93 billion shares, with the most viewed video reaching over 580 million views. These figures illustrate the growing acceptance and recognition of healthcare-related short videos among the public.

In the United States, TikTok is also becoming a platform for users to find and share health-related content. A study found that numerous disease education and medical knowledge videos have been published on TikTok, covering cervical cancer screening, COPD, diabetes, mental health, and more. One in five users seeks health advice on TikTok, and among Gen Z users, one in three obtains health information from the platform[3]. This trend is expected to continue. In 2024, the World Health Organization (WHO) and social medical platform TikTok announced a one-year collaboration to release a series of health-related videos that transform scientific information into relevant and easy-to-understand content.

[3] TikTok as a source of Health Information and Misinformation for Young Women in the United States: Survey Study, NIH National Library of Medicine

1.5 Emerging technologies continue to expand the boundaries of smart healthcare services

Emerging technologies such as artificial intelligence (AI), cloud computing, big data, the Internet of Things (IoT), and 5G are booming and providing solid technical support for smart healthcare. Their integration has reshaped the industry and played a crucial role in upgrading the value chain. With faster technological iterations, the depth of penetration and integration within the life sciences and health care industry continues to grow.

Figure 4: Empowering Smart Healthcare Development with Smart and Digital Technology

Medical Informatization: Before 2014	Online Healthcare: From 2014 to 2020	Smart Healthcare Innovations: From 2021 to now
• Informatize production and medical service activities, transitioning from paper-based records to electronic formats, which are then stored, processed, and transmitted within computer systems. • Key technologies: HIS, EMR, ERP system, etc. • Main applications: Management and maintenance of medical records, processing of medical imaging data, integration of medical information, etc.	• Promote the development of digital sharing and online services through secure network platforms on the basis of informatization. And enabling interconnection and interoperability across different institutions and regions. • Key technologies: Internet, cloud, IoT, blockchain, etc. • Main applications: Smart medication cabinets, comprehensive tracking throughout the patient journey, maintenance of medical devices, telemedicine services, etc.	• Drive innovative upgrades that enhance the quality and accessibility of medical services while offering more personalized options by integrating medical data and leveraging advanced smart technologies. • Key technologies: AI, cloud computing, big data analytics, 5G networks, etc. • Main applications: Clinical diagnosis and decision support, drug discovery, surgical robots, disease prediction, etc.

Source: Desktop research, Deloitte Research

Among these technologies, AI has seen the most comprehensive deployment in recent years and its importance in the healthcare sector has significantly increased. This is largely due to its powerful data analysis and generation capabilities, as well as its potential to synergize with other technologies to create more scenarios and deeper applications.

The market size for AI healthcare solutions is expected to exceed 20 billion RMB by 2025 and surpass 100 billion RMB by 2030, with a compound annual growth rate of 43.2%[4]. With ongoing advancements in new-generation AI technologies, more large medical models are emerging. These are demonstrating unique strengths in areas such as medical imaging diagnostics, pathology analysis, clinical decision support, and drug development, offering diverse opportunities for industry growth.

In addition, cutting-edge technologies like extended reality (XR) are also gaining traction in healthcare. XR is being applied in surgery, treatment, clinical assistance, and rehabilitation training. Medical XR (MXR), known for its realistic and standardized remote interventions and adaptability to different clinical settings, helps reduce costs and improve efficiency.

In surgery, MXR converts 2D digital images into 3D reconstructions of human tissues and organs, reducing the need for doctors to rely on imagination, enabling better planning, and shortening procedure time. MXR is also being used in real-time intraoperative guidance and expanding into areas like ADHD treatment in children and ophthalmology.

[4] White Paper on Healthcare Intelligence Industry, Frost & Sullivan, 2022

Smart Healthcare Large Model examples:

- **Medical Imaging Diagnosis and Pathology Analysis Case**: Multimodal interactive pathology large models are driving the intelligent development of pathology diagnostics. Ruijin Hospital, affiliated with Shanghai Jiao Tong University School of Medicine, in collaboration with Huawei, has launched the "RuiPath Pathology Large Model" (RuiPath). RuiPath can simultaneously acquire patients' pathology slide images, imaging examination results, medical history, and other clinical textual data, conducting a comprehensive analysis that more fully reflects disease characteristics and providing important references for clinical diagnosis and treatment. RuiPath's sub-specialty knowledge Q&A accuracy exceeds 90%. In terms of disease coverage, RuiPath includes 90% of the most common cancer cases diagnosed annually in China and, by learning from extensive rare disease case data, can identify unique pathological features. Furthermore, RuiPath can precisely identify lesions in advance, with AI diagnosis for a single pathology slide taking only a few seconds.
- **Clinical Assistance Case: Medical AI Agents provide multiple layers of medical support for both patients and doctors**. West China Hospital in Sichuan, in collaboration with Huawei, Shanghai Runda Medical Technology, and Chengdu Intelligent Computing Center, has released a medical AI agent "Ruibing Agent" that focused on the digestive field. This AI agent is divided into two platforms. First is "Dr. Yizhi", a mobile application for the public and patients, offering health education and full-cycle disease management services. On one hand, Dr. Yizhi can answer users' medical questions in a clear and understandable manner, and on the other, it provides personalized full-cycle management plans based on users' uploaded disease information. Another one is "Scholar Lunjie", a desktop platform designed for medical professionals, providing academic support functions to help doctors and medical students intelligently interpret academic articles.
- **Drug Development Case: AI-driven drug discovery platforms are accelerating new drug R&D**. Insilico Medicine's proprietary AI drug discovery platform, Pharma.AI, enables an end-to-end process covering target identification, drug discovery, and clinical trial prediction. The Pharma.AI platform consists of three core components, which are PandaOmics (identifies and discovers new drug targets), Chemistry42 (facilitates rapid discovery and optimization of early-stage drug compounds), and inClinico (predicts clinical trial outcomes and optimizes trial design). Pharma.AI can progress from target discovery to preclinical candidate compound (PCC) nomination in just 18 months, significantly reducing the timeline compared to traditional drug discovery processes. Currently, multiple biopharmaceutical companies, including Sanofi and Fosun Pharma, have partnered with Insilico Medicine for target discovery collaborations using Pharma AI.

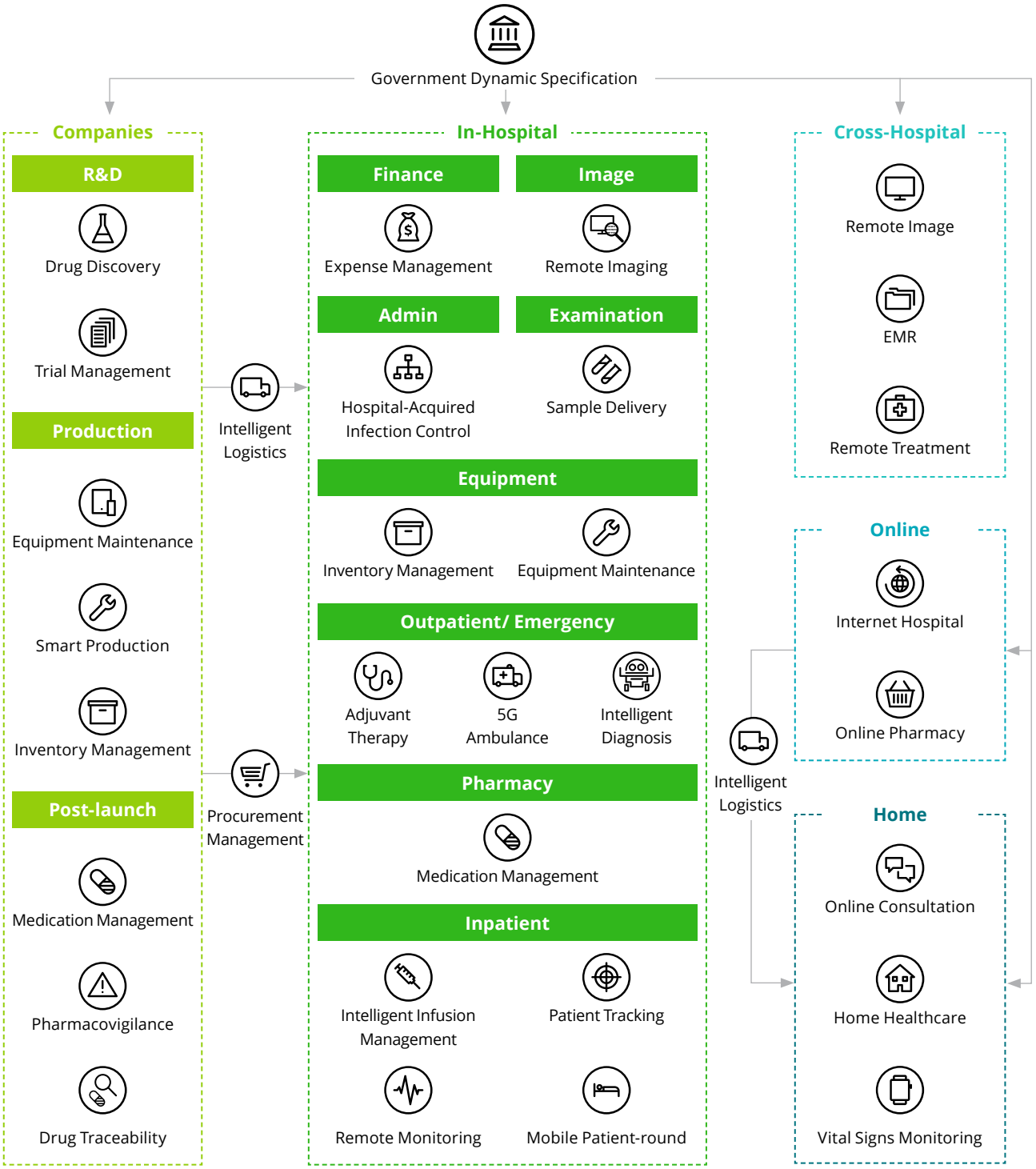
2. Diversified application scenarios of smart healthcare

Over the past decade, China's smart healthcare ecosystem has rapidly expanded. In particular, over the past three years, internet healthcare has introduced a broader range of application scenarios, including disease education, intelligent appointment scheduling, online consultations, remote diagnosis, and drug delivery services. These innovations have significantly improved medical accessibility and equity, creating new opportunities for the industry.

As of 2024, China's online healthcare users had reached 418 million, accounting for more than one-third of the total internet population[5]. Currently, with the integration of next-generation information technologies such as big data, the Internet of Things (IoT), 5G, and AI, the smart healthcare ecosystem continues to evolve and improve, placing greater emphasis on intelligence and personalization. This transformation is driving optimization across the entire value chain of the life sciences and health care industry. Pharmaceutical and medical device companies, healthcare institutions, and internet enterprises are accelerating the adoption of emerging technologies, particularly AI-powered large models, to enhance service efficiency, improve access to innovative medical solutions, and optimize patient experiences.

[5] China Internet Network Information Center (CNNIC)

Figure 5: China's smart healthcare ecosystem



Source: Deloitte Research

With the strengthened development of the smart healthcare ecosystem, a variety of ecosystem players have emerged, primarily tech companies. Leveraging their expertise in smart technologies, digital data, and innovation, these tech companies are leading efforts to integrate frontier technologies like AI and big data with healthcare, accelerating intelligent transformation across the industry.

After years of evolution, China's smart healthcare ecosystem has developed differentiated business models and service types. Some companies focus on B2B solutions for institutional digital transformation, while others specialize in front-line healthcare services through B2C platforms. On the B2B side, AI technologies are rapidly infiltrating healthcare. Leading tech firms are applying large AI models to clinical settings, examples include Huawei's Pangu Model, Tencent Cloud's Deep Intelligent Medicine, Baidu's LinearDesign, and Zhejiang University & Alibaba's HealthGPT.

On the B2C side, smart healthcare platforms and pharmaceutical e-commerce providers have built integrated service systems covering online consultations, e-prescriptions, pharmacy services, chronic disease management, and health management. Representative platforms include WeDoctor, Alibaba Health, and JD Health.

Moreover, many emerging tech companies specialized in smart healthcare are also popping up. Such as Insilico Medicine and XtalPi, which specialize in AI-driven drug discovery; Dingdang Health, which focuses on the O2O model in pharmaceuticals; and Yidu Tech, which provides solutions for medical diagnosis and treatment services. These emerging smart healthcare tech companies have all made significant achievements in their specialized fields.

Leading tech giants' layouts in smart healthcare:

Huawei **By leveraging core technological capabilities, including the Ascend AI framework, PanGu large model, and cloud computing, to build a comprehensive digital and intelligent ecosystem**

- **In collaboration with Runda Medical, Huawei has developed China's first AI healthcare consumption product, "Liangyi Xiaohui."** "Liangyi Xiaohui" can interpret medical test reports, covering explanations for over 4,500 examinations and 2,800 diseases, with a comprehensive accuracy rate of up to 87.7%.
- **Deep cooperation with Neusoft Group has led to the development of multiple intelligent medical devices and healthcare informatization products.** Leveraging Huawei Ascend AI models to empower several Neusoft medical device products, and launched "Neusoft & Huawei Clinical Doctor Assistant All-in-One Solution", which utilizing AI technology to comprehensively enhance the efficiency of doctors' daily clinical work.

Baidu **AI large models empowering all medical scenarios, promoting innovation in pharmaceutical R&D and the intelligentization of the medical industry chain**

- **Launched China's first industrial-level medical large model "ERNIE-Health".** ERINIE-Health focuses on real medical scenarios and provides a full-chain large model solution. It has accumulated nearly 100 types of medical AI machine learning tasks, integrating the smart medical service experience from over 800 hospitals, 2,000 pharmaceutical companies, and more than 4,000 primary care institutions, and successfully promoting pilot applications in medical institutions.

- **Introduced LinearDesign platform, which specialized in the algorithms for mRNA sequence design,** Baidu has published a groundbreaking achievement in the field of biocomputing in Nature[6] , becoming the first Chinese tech company to publish a paper in Nature. The LinearDesign algorithm effectively assists pharmaceutical companies in advancing more efficient mRNA vaccine development. In 2021, Sanofi introduced the LinearDesign algorithm to accelerate the R&D innovation of its next-generation mRNA vaccines.

JD Building an integrated internet medical service chain with smart technologies

- **Building a closed loop of online medical services encompassing "consultation + testing + diagnosis + medication."** JD Health focuses on developing an online service ecosystem of "medical services + retail pharmacy," constructing a one-stop medical service system. This system covers online consultations, online prescriptions, online retail pharmacies, and extends to home service scenarios, providing users with a seamless online-to-offline (O2O) home health service experience.
- **Launched two AI medical large models, "AI Jingyi" and "JOY DOC".** Introduced the full series of large model products for online scenarios, "AI Jingyi" features an AI diagnostic assistant 2.0 with a triage accuracy rate as high as 99.5%, and the efficiency of electronic medical record writing has increased by 120%. "JOY DOC," the first large model designed for complex hospital scenarios, introduces smart assistants tailored for both HCPs and patients, enhancing the efficiency of patient journey and hospital operations.

Tencent Building an AI agent ecosystem that covering the entire industry value chain

- **Launched 'Tencent Healthcare E-drug'.** Created a patient-centric one-stop value-added service platform for medication, assisting life sciences companies in effectively reaching their target patient groups and building private domains to achieve digital marketing.
- **Leveraging the strength of its self-built AI platform to support life sciences companies in developing smart healthcare models.** Collaborated with CR Sanjiu, Tencent Cloud has developed an AI health management entity known as "Sanjiu Health Butler." Tencent also partnered with Mindray Medical to accelerate the integration of AI technology in vitro diagnostics, relying on the capabilities of Tencent AI Lab and Tencent Miying.

Alibaba Utilize AI to empower the entire chain of online medical services, building data-driven smart healthcare

- **Alibaba's DAMO Academy has launched its independently developed AI cancer tool "DAMO Panda".** DAMO Panda is an AI model for pancreatic cancer screening developed by Alibaba DAMO Academy, which received the Breakthrough Device designation from the U.S. FDA in 2025, becoming the first domestically produced AI product to receive such certification.
- **Alibaba backed Alipay has launched several AI-driven healthcare innovation applications.** Collaborated with the Health Commission of Zhejiang Province, Alipay introduced the nation's first digital health companion "Anzhener (安诊儿)",which offers AI-assisted medical services such as cloud-based accompaniment and health consultations to residents. Additionally, partnered with the First People's Hospital of Shanghai, Alipay launched Shanghai's first voice-interactive "digital medical companion" and generative electronic medical records, enhancing the efficiency of doctors' outpatient services.

[6] Zhang, H., Zhang, L., Lin, A. et al. Algorithm for optimized mRNA design improves stability and immunogenicity. Nature 621, 396–403 (2023). https://doi.org/10.1038/s41586-023-06127-z

Emerging tech companies are laying out strategies for smart healthcare:

YiduTech **Providing precise medical solutions for key stakeholders in the life sciences and health care industry**

- **Launched Medical Intelligence Brain, YiduCore.** YiduCore aggregates and transforms raw medical datasets into structured and standardized data for hospitals. Currently, YiduCore is embedded in over 2.6 billion full-cycle medical records, covering more than 600 million patients, and offers models based on real-world evidence.
- **Launched the AI doctor for liver cancer "Xiao Gan Ren (小肝人)" in collaborated with Southeast University.** Partnered with Southeast University and DeepSeek, China's first intelligent entity for liver cancer diagnosis and treatment "Xiao Gan Ren (小肝人)" has been introduced, which leveraging DeepSeek's reasoning capabilities and YiduCore's specialized medical disease cognition to provide patients with disease consultation and report interpretation services.

DingDang Health **Providing integrated online and offline smart pharmacy services**

- **Dingdang Kuaiyao provides integrated online and offline smart pharmacy services.** It has established multiple smart pharmacies in first-tier cities, offering medical O2O services. Successfully building an O2O model that enables the supply of medicines from pharmaceutical companies to physical pharmacies and has now expanded into medical, delivery, and insurance services.
- **Launched the AI Health Assistant "Smart Dingdang".** Based on multimodal interaction technology, the AI Health Assistant "Smart Dingdang" has been developed, integrating DeepSeek and Tencent Hunyuan large models to provide users with common medical consultation services. Its core functions include intelligent symptom analysis and comprehensive health management services, further implementing the construction of tiered diagnosis and treatment.

Huimei Technology **Offering medical AI solutions based on clinical decision support systems (CDSS)**

- **Launched the Huimei Medical AI Solution "Dr. Mayson".** Built on a foundation of data, Dr. Mayson integrates an evidence-based medical knowledge base and provides AI solutions for clinical decision-making through CDSS 3.0 technology, enhancing the efficiency of doctors' diagnoses and treatments. As of May 2024, Dr. Mayson has been implemented in nearly 900 hospitals across the country.
- **Launched the Huimei Clinical Research Platform "Darwin".** Leveraging the advantages of CDSS technology and data capabilities, Darwin is designed to provide services such as research quality control, real-time data collection, and real-world studies to clinical researchers. By utilizing smart technologies, it accelerates the progress of research projects and enhances the efficiency and process quality management of hospital GCP projects.

iFLYTEK Medical **A healthcare solutions provider utilizing artificial intelligence**

- **Launched the iFLYTEK SPARK Large Model X1.** Developed using entirely domestic computing power, the iFLYTEK SPARK Large Model X1 continues to lead in performance across six core medical capabilities: medical knowledge Q&A, medical diagnosis and treatment recommendations, generation of medical professional documents, and medical multi-modal interaction. The comprehensive diagnostic capabilities in cardiology, respiratory medicine, and pediatrics have reached the level of attending physicians at tertiary hospitals, surpassing OpenAI-o3 and Deepseek R1.
- **Launched the personal health management assistant "Xunfei Xiao Yi".** Based on the capabilities of the iFLYTEK SPARK Large Model, the Xunfei Xiao Yi app has been launched, simulating a doctor's consultation based on the digital health space, providing users with comprehensive health management services covering all scenarios from pre-diagnosis, during treatment, and post-examination.

Figure 6: JD Health Business Model

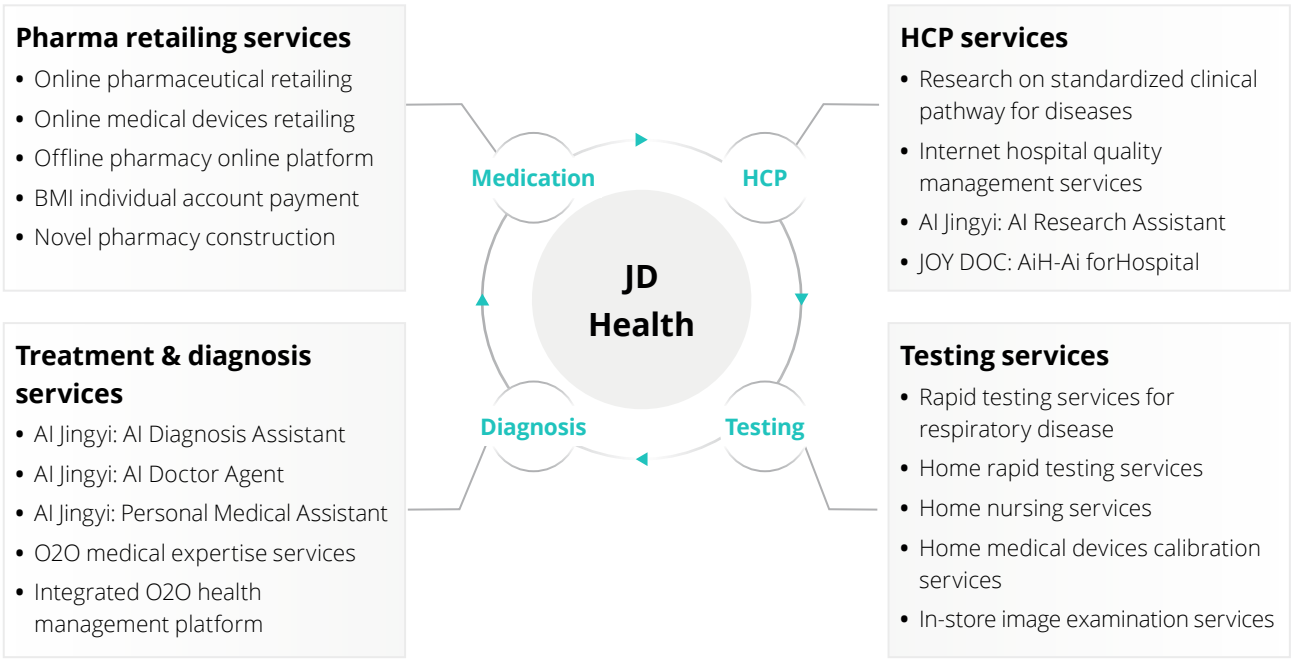
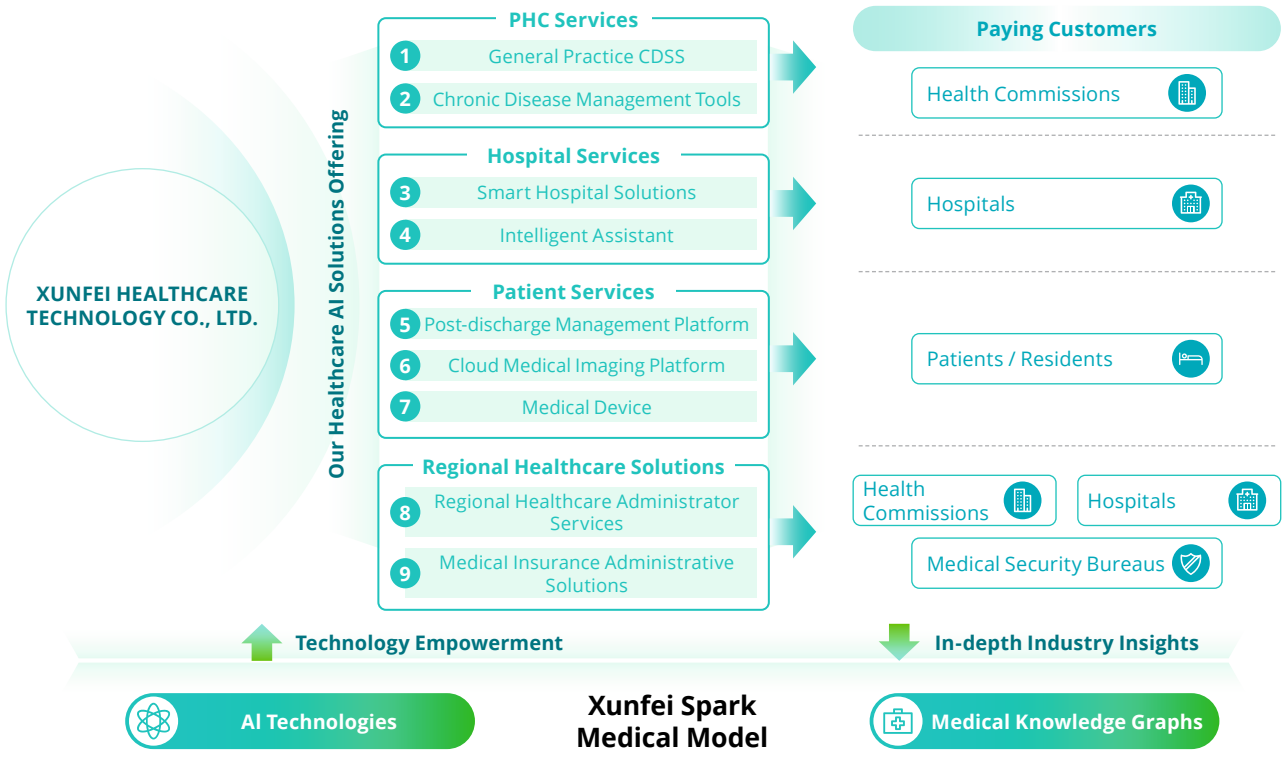


Figure 7: Xunfei Healthcare Business Model



2.1 Further deepened innovation value chain

The new generation of digital and intelligent technologies continues to empower the full life cycle of pharmaceutical manufacturing. As early as 2015, the "Made in China 2025" strategy identified biopharmaceuticals as one of the ten key development sectors, emphasizing the advancement of intelligence within the pharmaceutical industry. Today, many pharmaceutical and medical device companies have successfully adopted technologies such as AI, IoT, big data, and cloud computing.

For instance, in drug R&D, the integration of AI and big data enables efficient processing of massive datasets, shortening the research timeline and facilitating target screening, drug design, and toxicity prediction. In drug production, IoT and cloud technologies ensure precise control over material proportions, environmental parameters, and equipment operations, reducing error rates and improving product quality. In marketing, new digital marketing models based on intelligent technologies allow for more precise and flexible promotion strategies. Among these, digital transformation is progressing most rapidly in the R&D and marketing phases.

Figure 8: Strategic applications of smart technology across the R&D value chain

Application scenarios	Role of smart technology	Value levers
Drug repurposing	• Perform meta-analysis of clinical trial and research data to generate high quality hypothesis for drug repurposing	• Reduced pre-clinical costs and time to market • Higher NDAs success
AI-driven drug discovery	• Optimise target and biomarker identification and shortlisting candidates while assessing toxicity and therapeutic efficacy	• Improved clinical success rate • Higher number of NDAs
Rapid design and startup	• Automated protocol generation, drafting of study documents (consent form, agreements) and regulatory submissions	• Lower average protocol authoring time • Lower average time to first enrollment
Digital data flow	• Collate and standardise trial data elements to create analysis-ready data sets and to auto-populate tables and charts in trial artifacts	• Reduced total time per phase and faster documentation creation • On-time database lock
Regulatory intel and submission excellence	• Identify regulatory requirements across geographies, generate drafts of dossiers, and understand competitor regulatory strategy	• Higher regulatory success
Participant experiences	• Enhancing participant experiences with strategic nudges to revolutionize recruitment and retention strategies	• Reduced drop out rate and faster recruitment • Lower terminations rate

Source: Desktop research, Deloitte Research

The smart transformation of the entire value chain of life sciences industry continues. Under the backdrop of increasingly stringent compliance requirements, pharmaceutical and medical devices companies need to pay more attention to compliance management related to smart technology utilization. When leveraging emerging technologies such as big data, blockchain, and privacy computing, they must ensure data privacy while collecting data from all stages of the industrial chain. And further compare and verify it with relevant national compliance requirements to solve the problem of low efficiency of manual compliance.

Looking ahead, pharmaceutical and medical device companies are expected to move toward higher-level smart manufacturing. Technologies such as big data analytics, automated control systems, and digital twins will be gradually applied to the production process. These will enable comprehensive integration of production elements and support automated, electronic, and standardized data recording, ultimately enhancing process control through data-driven insights.

Case Study: AI-Powered Protein Drug Development

Beijing Zhidao Biotech uses a combination of CADD (Computer-Aided Drug Design) and AIDD (AI-Aided Drug Design), along with its proprietary high-throughput protein screening technology, to develop multiple novel recombinant protein drug pipelines. These target areas include oncology, metabolic diseases, and rare diseases.

The company has established full-process capabilities for biologics, from computer-assisted design to manufacturing using “directed refolding” technology. As of August 2023, Zhidao Biotech had applied for over 40 national invention patents and licensed more than 10 technologies externally.

2.2 Deepening regional medical intelligence

Smart healthcare is increasingly becoming a mainstream trend in the transformation of the medical system. Within this trend, regional healthcare, an essential component of the overall system, is becoming more closely integrated with smart healthcare initiatives. Regional healthcare plays a crucial role in optimizing the distribution of medical resources and guiding the expansion and decentralization of high-quality healthcare services. The Chinese government has explicitly identified the development of Regional Medical Consortiums ("Regional Medical Alliances") as a key approach to enhancing primary healthcare institutions and promoting the implementation of a hierarchical diagnosis and treatment system.

To further amplify the practical impact of Regional Medical Alliances, integrating smart and digital technologies to form Smart Medical Alliances has become increasingly important. By leveraging these technologies, Smart Medical Alliances can consolidate regional resources, creating a hierarchical medical system that fosters upward and downward coordination within regions. Regional Medical Alliances encompass four primary models: urban medical groups, county-level medical communities, cross-regional specialty alliances, and remote medical collaboration networks. The digital transformation of all four models is now fully underway.

- **City-level medical groups build collaborative digital platforms to optimize resource allocation and utilization.** For example, Chaoyang District in Beijing has established four regional healthcare networks centered on major hospitals such as China-Japan Friendship Hospital and Anzhen Hospital. Five central guidance hubs oversee pathology, diagnostics, disinfection, and other medical services throughout the district, providing technical support and training for affiliated institutions.
- **County-level communities are promoting smart upgrades of information systems to break spatial constraints.** Over 2,100 counties across China have launched integrated county-level healthcare systems. These allow the sharing of resources like imaging, diagnostics, and ECG interpretation. Tech companies such as Neusoft have introduced "8+1" smart solutions tailored for these county systems, helping deliver precise diagnostics and analytics. Since 2017, Neusoft has contributed to RMC development in 14 provinces, including Shanxi, Henan, Yunnan, and Guizhou.
- **Cross-regional specialty alliances focus on IT integration to enable shared diagnostic data.** In 2023, hospitals in Sichuan and Chongqing formed 46 such alliances in areas such as oncology, liver disease, orthopedics, and respiratory health, covering 941 hospitals. Of these, 291 secondary and tertiary public hospitals now recognize 112 mutual diagnostic tests, with nearly 2 million cases shared. Nationwide, over 3,900 specialty alliances have been established, enabling over 15,600 technical advancements at the grassroots level.
- **Telemedicine networks expand access for rural and remote areas.** For instance, the Zhoushan Archipelago Network Hospital connects isolated island hospitals with mainland experts for remote consultations. As of now, Zhoushan's network includes 8 regional telemedicine centers and 208 grassroots service stations. Tele-radiology and ECG interpretation have been extended to all qualified township clinics.

In summary, smart and digital technologies are accelerating the development of China's Regional Medical Alliances and have already begun to show tangible results. Leading hospitals are transforming into open and shared high-quality medical platforms, transferring advanced diagnostic and treatment technologies, extensive clinical experience, and standardized treatment protocols to primary healthcare institutions. This enables grassroots medical professionals and patients to access cutting-edge medical technologies and concepts, ultimately improving the quality of healthcare services available to them. This progress reflects the steady advancement of the hierarchical medical system.

As a key focus of national healthcare development, the next steps for hierarchical medical system will involve leveraging medical insurance payment policies and pricing mechanisms to encourage patients to seek treatment at primary healthcare facilities. Additionally, various channels will be utilized to enhance public education and awareness, increasing patient understanding and acceptance of the system. By guiding patients to adjust their healthcare-seeking behaviors and make informed choices about medical institutions, the system aims to optimize healthcare resource allocation and further strengthen its implementation.

Case 2: County-Level Medical Reform in Gansu Province

In Zhangye City, Gansu Province, three county-level hospitals established integrated healthcare communities together with local township health centers. These entities jointly built a unified information platform to support a range of smart healthcare services, including remote radiology, diagnostics, consultations, and two-way referrals.

The platform launched in May 2022 and has since enabled more than 2,600 remote services. These include remote readings of medical images, specialist consultations, and real-time communication between township clinics and county hospitals. As a result, county-level inpatient rates increased by 5.48%, while outpatient and inpatient visits to primary-level medical institutions grew by 25% and 89% respectively. The reform has significantly improved the efficiency and reach of healthcare services at the grassroots level.

2.3 Greater emphasis on the construction of smart hospitals

Smart hospitals are a core pillar of smart healthcare. In March 2019, the National Health Commission formally defined "smart hospitals" as those that use technologies such as big data, AI, and IoT to establish intelligent management systems and deliver higher-quality healthcare.

Electronic medical records (EMRs) are the foundation of smart hospitals. EMRs connect to core hospital systems such as HIS, PACS, and LIS, allowing for seamless data integration across departments. From 2021 to 2022, 86.16% of healthcare institutions listed EMR integration as their top IT priority[7]. National regulators have also recognized EMRs as central to hospital informatization and are accelerating their adoption.

For the construction of EMRs, hospitals mainly adopt the approach of collaborating with EMR solution providers. Leading EMR solution providers typically possess independently developed core technology systems and have established mature and stable EMR product lines, collaborating with many hospitals to promote the in-hospital application of EMRs.

For example, Goodwill has established a full range of general medical record templates, which combining the characteristics of pediatric clinical practice, for the Children's Hospital affiliated with Capital Medical University; Haitai Medical has helped Xuanwu Hospital build inpatient, outpatient, and emergency EMR systems, and based on EMRs, constructed advanced applications such as paperless management, voice input, and CDSS; Neusoft Group has promoted the use of EMRs across all clinical departments at Shengjing Hospital, forming various distinctive digital healthcare models.

As the importance of EMRs continues to rise, these companies with product advantages will welcome greater development opportunities.

In May 2020, the National Health Commission explicitly defined the EMR as the core and foundation of smart hospitals, advocating for hospital informatization centered around EMR development. According to the *Electronic Medical Record System Application Level Classification Evaluation Standard (Trial)*, EMR system application levels are divided into nine tiers, with each level specifying requirements for various EMR subsystem components as well as the overall hospital-wide EMR system.

In the *2021 National Performance Evaluation Report for Tertiary Public Hospitals*, the NHC stated that by 2022, the average EMR application level in secondary and tertiary public hospitals should reach Level 3 and Level 4, respectively. This means that secondary public hospitals must achieve interdepartmental EMR data exchange, while tertiary public hospitals should enable hospital-wide EMR data sharing to support basic clinical decision-making. At present, Level 4 EMR implementation in public hospitals is nearly complete.

At the same time, the ongoing DRG/DIP payment reform is further driving the continuous upgrading of EMR systems. According to the *Three-Year Action Plan for DRG/DIP Payment Reform*, by the end of 2025, the DRG/DIP payment model is expected to cover all eligible inpatient medical institutions, with full coverage of disease categories and healthcare insurance funds. The EMR system serves as the foundation for implementing DRG/DIP payment reform, as all data collected for this payment model originates from electronic medical records.

Therefore, hospitals must continue upgrading their EMR levels to align with standardized clinical pathways. According to the EMR rating standards, hospitals need to reach Level 5–6, which involves achieving unified data management or full-process medical data closed-loop management, supporting intermediate to advanced clinical decision-making. Furthermore, DRG grouping includes both general and specialized clinical data, but a generic EMR system cannot fully meet the management needs of specialized departments. As a result, specialized EMR systems, which offer greater clinical depth and are better aligned with the workflows of specific medical specialties, are expected to develop at an accelerated pace.

[7] 2021-2022 Survey on the Informatization Status of Chinese Hospitals, CHIMA, February 2023

Case 3: Goodwill Electronic Medical Records Platform

Goodwill's EMR products include inpatient and outpatient EMR systems, targeting the inpatient and outpatient business scenarios of medical institutions, respectively. Goodwill's EMR system features a proprietary XML-based EMR editor that supports the specialization and standardization of templates according to EMR management requirements.

Additionally, the platform provides users with a 360-degree view of patient diagnostic and treatment information, integrating and categorizing patients' hospitalization records for comprehensive presentation by subject. Furthermore, Goodwill's EMR system seamlessly integrates with clinical pathway systems, enabling unified management across multiple hospital campuses and interconnectivity of data across different departments and campuses. By the end of 2023, Goodwill's EMR system covered more than 1,500 hospitals nationwide, including over 500 tertiary hospitals.

2.4 Rapid development of smart healthcare at home

With the aging population accelerating and the number of chronic disease patients increasing, alongside the growing awareness of health management, smart healthcare is expanding into the home health sector. China's elderly care model follows a "9037" structure, where 90% of elderly individuals choose home-based care, 7% rely on community-based support, and 3% reside in elderly care institutions.

While this unique elderly care model presents new opportunities, it also brings various challenges, such as insufficient professional caregiving skills, shortages of medical resources and personnel, and inadequate safety monitoring. Additionally, the increasing demand for more efficient, precise, and personalized self-health management is outpacing the capabilities of traditional healthcare service models.

Against this backdrop, the application of smart healthcare in home settings is gaining prominence. Smart home healthcare leverages intelligent technologies to enable remote connectivity, integrating online services such as internet hospitals and online pharmacies to enhance consultations, health monitoring, and home medical care.

For example, online medical consultations allow patients to have video calls with doctors from home and receive professional medical advice; smart wearables and medical devices, such as smart wristbands, smartwatches, and smart pill dispensers, enabling real-time monitoring of vital signs like heart rate, blood pressure, and blood glucose while also reminding patients to take their medications on time; Remote medical technologies provide patients with specialized nursing and rehabilitation guidance, covering aspects such as daily activities, diet, and exercise.

To enhance the value of smart home healthcare, the government is actively promoting the family doctor contract service. This initiative, designed as a public welfare project, is built on community health service centers (including township health clinics), forming medical teams led primarily by general practitioners (GPs). Through contractual agreements, qualified family doctors (GPs or clinical doctors) establish long-term and stable service relationships with the signed households.

Family doctors are responsible for providing preventive healthcare, diagnosis and treatment of common diseases, referrals, patient rehabilitation, chronic disease management, and overall health management, with the aid of smart digital technologies to ensure comprehensive coverage and diversified services.

Currently, community health service centers are actively promoting this initiative. Medical staff, together with community grid workers, are conducting home visits to educate residents about the contract service policies and identify those in need, such as chronic disease patients and elderly individuals with disabilities or cognitive impairments. At this stage, the government

is working to ensure all family doctor contract services are fully digitized. By establishing and improving the family doctor service and management information system, residents can now access online services, including contract signing, health consultations, chronic disease follow-ups, and two-way referrals, tailored to their individual healthcare needs.

In terms of new home and community-based medical equipment, an increasing number of lightweight and portable medical devices are being rapidly adopted for home use. These medical devices can not only accurately monitor key health data, such as heart rate, blood glucose levels, and blood oxygen saturation, but also analyze users' health conditions using AI, even predicting potential health risks.

In addition, smart companion robots equipped with health management functions are gradually appearing in home and community elderly care scenarios as well. These robots not only provide users with life assistance and emotional companionship services but also play a significant role in areas such as elderly disease monitoring and fall detection.

Figure 9: Smart healthcare applications in home care scenario

Smart healthcare at home

Online scenarios		Offline scenarios	
iHospital/ remote healthcare	**Online pharmacies**	**Health monitoring and management**	**Smart notification and care**
Representative enterprises	**Representative enterprises**	**Representative enterprises**	**Representative enterprises**
• Ping An Good Doctor • AliHealth • Haodf.com • JD Health • Baidu Health • WeDoctor	• AliHealth • Best Pharmacist • JD Health • YSB Inc. • Meituan Maiyao • Yaofangwang • Dingdang Kuaiyao • 111, Inc.	• Cofoe • Lepu Medical • Huawei • Sinocare • Lifesense • Andon • Yuwell • ChoiceMMed • Xiaomi	• EWELL • Msense • UNITREE • UBTECH • OMRON • WEILAN • Enabot

Source: Desktop research, Deloitte Research

Case 4: 5G Quick-Signature Family Doctor Online Contracting Service

China Mobile Internet Co., Ltd.'s 5G Quick-Signature service provides intelligent lifecycle contract management for family doctors, including identity verification, digital certificates, electronic signatures, evidence preservation, and judicial services. Through 5G Quick-Signature, medical institutions can quickly reach residents in various ways, reminding them to sign contracts with family doctors. Residents can select their preferred family doctor online, fill out personal information, and undergo real-time identity verification to ensure data accuracy.

Notably, elderly individuals aged 65 and above can have family members sign contracts on their behalf online, demonstrating how technology can assist the elderly. This solution has been implemented in multiple cities, including Guangzhou, Dongguan, and Foshan, covering a population of over 2 million residents.

3. Challenges in the Smart Healthcare Industry

The development of smart healthcare has achieved significant progress but still faces numerous challenges.

3.1 Obstacles to interconnectivity within and between hospitals

Within public hospitals, the degree of digitalization varies across departments. Some departments exhibit high management standards and good data quality, while others lag in digital adoption, leading to poor data collection and lower data quality. Even when hospitals possess the necessary technologies, such imbalanced development hinders full data sharing.

Between public hospitals, data collection frameworks and medical information systems are often sourced from different vendors, resulting in inconsistencies in data standards, formats, and descriptions. These discrepancies create barriers to inter-hospital connectivity, forming data silos that prevent real-time and efficient medical data exchange.

Among private hospitals, although specific requirements for the informatization construction of private hospitals have not yet been proposed at the highest level, under the broad context of medical informatization, private hospitals are still making investments in informatization according to their own characteristics and actual needs.

3.2 Limited adaptability of medical staff and patients to smart healthcare

Both patients and healthcare professionals face challenges in adapting to new digital and intelligent technologies. For patients, smart healthcare platforms and applications often feature complex functions and operations. Some patients, particularly older individuals or those with lower education levels, struggle with usability due to limited digital literacy. Additionally, highly technical medical content can be difficult to understand, leading to mistrust in digital platforms and reduced willingness to use them.

For healthcare professionals, adopting new medical devices and software requires additional training and learning time. These new tools may disrupt existing medical workflows, potentially affecting work efficiency and service quality. Insufficient training can result in resistance among medical staff, as they may perceive smart healthcare as failing to meet expectations.

3.3 Policies and regulations for smart healthcare need to be further improved

As digital and intelligent technologies expand across industries, the government has introduced several regulatory policies for emerging technologies, such as *Guidelines on Strengthening Scientific and Technological Ethics Governance, Interim Measures for the Administration of Generative AI Services, Artificial Intelligence Security Governance Framework*, etc. However, these policies remain at the legislative level and lack specific governance regulations for smart healthcare applications. There are unclear standards for the application, responsibilities, and obligations of digital intelligence technologies in various healthcare scenarios. This regulatory lag creates a contradiction between the rapid development of smart healthcare and slow policy adaptation.

Moreover, data security and privacy protection are growing concerns. The widespread adoption of smart healthcare involves the collection, storage, transmission, and processing of vast amounts of patient data, increasing risks associated with technical vulnerabilities and network security threats. Organizations and enterprises face heightened risks of data breaches or misuse. The expansion of telemedicine and online healthcare services has further widened the scope of medical data interconnectivity, increasing the risk of patient privacy leaks. As public awareness of data protection grows, any failure to ensure proper patient data security could severely erode trust in smart healthcare services.

Additionally, digital intelligence technologies themselves face stability issues. Smart healthcare integrates AI, big data, and cloud computing, but these technologies are still in a rapid development phase with limited maturity. System crashes and data errors remain possible, affecting the quality and reliability of services. In particular, AI algorithms can be influenced by data quality and training methods, leading to inaccurate or biased outputs, which can negatively impact medical decision-making.

3.4 Smart healthcare services face pricing and payment challenges

Smart healthcare relies on advanced technologies such as AI, big data, and cloud computing, which require significant investment in research and maintenance. A key challenge is how to absorb these costs while maintaining reasonable pricing. Additionally, pricing strategies must account for market acceptance, patient affordability, and healthcare insurance constraints.

On the payment side, new smart healthcare services may not be covered by public health insurance, forcing patients to pay out-of-pocket, increasing financial burdens and hindering adoption. Furthermore, regional disparities in reimbursement policies create challenges in cost settlement and payments.

Another difficulty lies in risk assessment and reimbursement calculations for smart healthcare services. These require large-scale clinical data analysis, but most of this data is not publicly available, making it difficult for companies to design appropriate insurance products. This limits reimbursement channels, further affecting the widespread adoption of smart healthcare solutions.

4. Outlook and suggestions

In response to the above challenges, we have summarized four key recommendations.

4.1 Establish unified standards and task Forces within Hospitals; government-led data standardization across medical institutions

At the hospital level, institutions should define a comprehensive blueprint for their digital transformation efforts. Each hospital should develop an information infrastructure plan tailored to its needs and promote hospital-wide informatization from the top down. A dedicated task force should be established to unify construction standards and oversee implementation. In parallel, incentive and accountability mechanisms should be created to encourage timely data input and feedback by frontline staff, and to standardize the management practices and data quality across departments.

At the inter-hospital level, government leadership is crucial for resolving data-sharing issues. Authorities should collaborate with industry associations and hospitals to identify major obstacles, then establish unified technical standards for system interfaces, data formats, and transmission protocols. These standards would ensure seamless system integration and data interoperability among institutions. Additionally, government agencies can publish a “whitelist” of certified integration platforms, and hospitals can submit infrastructure proposals to be centrally procured and deployed by national and local governments.

4.2 Patient education via multiple channels and personalized solutions; strengthen external collaboration for smart technology adoption

For patients, digital tools should be used to broadly and effectively promote smart healthcare. National campaigns should be launched through mainstream media, with targeted outreach at the community level. Increased utilization of official WeChat accounts, video channels, and other platforms can help demonstrate the convenience and efficiency of smart healthcare, thereby improving patient awareness and acceptance.

Special functions and devices should be designed to meet the needs of specific groups, such as elderly patients or those affected by shifting demographics, thereby enhancing inclusivity.

For healthcare workers, hospitals should actively conduct smart healthcare training programs. By partnering with government agencies or technology firms, hospitals can deliver tiered training based on job roles to raise awareness of smart healthcare. For example, Zhongnan Hospital of Wuhan University successfully hosted a course titled “Basics and Practical Applications of AI in Healthcare.” As such training becomes more common, medical staff will grow more comfortable with smart technologies and be more likely to embrace innovation.

Hospitals may also develop assessment frameworks and incentive mechanisms to encourage adoption during clinical operations and ensure the real-world implementation of smart healthcare.

4.3 Strengthen data security barriers and clarify legal and technical standards

Data security and patient privacy must be protected through careful management and technical safeguards.

During data collection, the principle of data minimization should be followed, only information directly relevant to healthcare services should be gathered. Patients must be informed and give explicit consent. In terms of data management, patient data should be classified and protected according to sensitivity. For example, medical conditions and genetic information should fall under the highest level of protection. Access control systems should be implemented to strictly manage permissions, and all data access and operations should be logged for auditing and traceability.

From a technical standpoint, encryption should be applied during data storage and transmission. Regular security assessments and vulnerability scans should be performed. Real-time monitoring tools should be used to detect anomalies and identify privacy risks promptly.

To foster the healthy development of AI in healthcare, legal definitions and responsibility frameworks must be established. Regulations should clarify the legal status of AI in medicine, whether AI systems have legal standing and define the roles and liabilities of doctors, medical institutions, patients, and AI developers within this ecosystem.

On the technical side, standards must be set for AI-enabled medical devices. These include algorithm evaluation criteria and protocols for clinical validation. Guidelines should also be created for clinical personnel on how to use AI devices during diagnosis and treatment, ensuring alignment with safety and professional standards. Independent agencies for AI medical evaluation and certification should be established to regularly assess products and approve only those that meet safety and effectiveness requirements for clinical use.

4.4 Design reasonable, granular pricing strategies; build a diversified payment system and novel payment mechanisms

Pricing for smart healthcare services should be managed based on provider type. For public institutions offering “Internet + Healthcare” services, prices are primarily regulated by government authorities. The National Healthcare Security Administration (NHSA) is revising pricing structures for services such as AI-assisted diagnostics, reconstructing legacy categories and creating space for new technologies in the fee system.

Although the price of smart healthcare services provided by non-public medical institutions is regulated by the market, local regulatory authorities should still take timely supervision to maintain the stability of market prices.

A multi-party payment system should be gradually established for smart healthcare. Given that the NHSA will officially introduce Category C listings in 2025 as a supplement to the basic reimbursement catalog, a “dedicated commercial insurance pool” model may be extended to smart healthcare services. The NHSA, commercial insurers, and smart healthcare companies can jointly define project categories to integrate eligible services into public insurance.

Insurance providers may also work directly with smart healthcare firms to develop customized insurance products, especially for services like telemedicine, and improve claim settlement mechanisms to reduce patients’ financial burden.

5. Conclusion

Smart healthcare is reshaping China's life sciences and health care industry, driving innovation in resource allocation and service models. Driven by the synergy of intelligent technologies such as 5G, artificial intelligence (AI), and big data, traditional spatial barriers within the healthcare system are gradually being dismantled, thereby enhancing medical equity and accessibility.

Specifically, remote diagnosis and treatment systems facilitate the flow of high-quality resources from large hospitals to primary healthcare institutions through teleconsultation, as well as the transmission and sharing of medical data, such as medical imaging and pathological slides. This effectively mitigates deficiencies in technology and diagnostic experience at the grassroots level while better meeting the medical needs of local patients.

The empowerment of smart and digital technologies is not only reflected in the improvements in medical equity and accessibility but also significantly impacts the efficiency of healthcare institutions and pharmaceutical and medical device companies. In hospital settings, the application of electronic medical record (EMR) systems enables medical staff to access and update patient information in real time, improving work efficiency. In the pharmaceutical and medical device sector, AI-driven intelligent technologies continuously optimize R&D, production, and marketing processes, ensuring product quality while shortening overall business timelines.

As a core driver in establishing a high-quality and efficient healthcare service system, smart healthcare continues to expand the "breadth" and "depth" of the life sciences and health care industry. It is gradually encompassing the entire industry chain, from the R&D and production phases of pharmaceutical and medical device companies to the full spectrum of medical services and health management. Additionally, smart healthcare fosters more diversified service models, catering to increasingly personalized medical needs.

The ongoing development of smart healthcare has had a profound and positive impact on China's healthcare landscape. Policy advancements, evolving demand, and technological progress will remain key drivers of rapid growth in the sector.

However, it is important to acknowledge the challenges associated with its development, given the involvement of multiple stakeholders, diverse medical projects, and the continuous iteration of technology. These challenges span across dimensions such as data security, privacy protection, technological risks, pricing, and payment mechanisms. Addressing these issues requires concerted efforts from the government, healthcare institutions, and technology enterprises to strengthen cross-sector collaboration and formulate comprehensive solutions that ensure the compliant and ethical advancement of smart healthcare.

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