
INDUSTRY OVERVIEW

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SOURCE AND RELIABILITY OF INFORMATION

We commissioned iResearch to conduct market research and analysis, and to produce the iResearch Report on the healthcare big data industry in the PRC at a fee of RMB500,000, which we believe reflects market rates for reports of this type. iResearch provides professional industry analysis, data insights, market research, strategic consulting and digital solution to clients, focusing on China's new economy and the sectors of industry digital insight research and consulting services. iResearch has published more than 3,000 industry research reports since its establishment in 2002. The iResearch Report has been prepared by iResearch independent of our influence and that of other interested parties. Unless and except as otherwise specified, the market and industry information and data presented in this Industry Overview section are derived from the iResearch Report.

The industry data and related market forecasts in the iResearch Report, including the ranking of industry players, were mainly obtained by iResearch through primary and secondary research, including publicly available information such as annual reports, industry and company interviews, market surveys, desktop research, sampling and other research methods utilizing information and statistics published by government departments, publications and studies by industry experts, online resources, data from iResearch's database and its statistical prediction model. Reliability of relevant data was ascertained by cross-validation between multiple sources. Rankings are based on directly obtained figures and calculations based on existing figures and business performance. Basic assumptions for the iResearch Report are that there are no major omissions in the publicly available data and that future market developments are in line with conventional development patterns.

Our Directors confirm that, to the best of their knowledge, after making reasonable enquiries, there has been no material adverse change in the market information since the date of the iResearch Report which may qualify, contradict or have an impact in any material respect on the information in this section.

INDUSTRY OVERVIEW

MACRO ECONOMY OF THE HEALTHCARE INDUSTRY IN THE PRC

Huge market size of China's healthcare industry, backed by factors such as aging population and increasing personal disposable income

The demand for capital in China's healthcare industry in 2020 exceeded RMB8.0 trillion, with a year-on-year increase of 14.7%, of which in-hospital medical care services accounted for the largest proportion, followed by out-of-hospital and internet medical care services. China's healthcare market size grew at a CAGR of 10.9% from 2016 to 2020 and is expected to grow at a CAGR of 12.7% from 2020 to 2026.

With the development of China's economy, the per capita disposable income of Chinese residents has increased consistently. The per capita disposable income reached RMB32,189 in 2020 and is estimated to exceed RMB40,000 by 2024. The increase in income will inevitably boost consumption and prosperity. The proportion of income spent on healthcare grew from 7.6% in 2016 to 8.7% in 2020, and is expected to grow to more than 10% in 2026. The main reasons for this growth include: (i) the government and the medical community putting in increased efforts to promote medical and healthcare knowledge; (ii) the healthcare awareness of Chinese residents gradually increasing as they are paying more attention to their own healthcare problems; and (iii) healthcare products becoming increasingly diversified which provides more options for consumers.

Industry weaknesses encourage reform by utilizing Internet+ to improve efficiency of the entire industry

The healthcare industry in China currently faces many challenges, such as:

- (i) ***Imbalanced resources distribution between urban and rural areas.*** According to the 2020 China Healthcare Statistics Yearbook, the total number of registered physicians in eastern China is far higher than that in central and western China, along with obvious differences between urban and rural areas. The number of doctors per thousand people in China is 1.79, only ranking 90th in the world. However, this figure is about 4.63 in the Beijing area and 2.95 in the Shanghai area. In contrast, the primary healthcare resources in rural areas cannot meet the healthcare needs of the vast rural masses.
- (ii) ***Necessary transformation to research and development efficiency and marketing model of medical product manufacturers.*** Medical product manufacturers are facing an increasingly fierce competitive environment, higher research and development costs and declining profits. In addition, government and regulatory agencies are implementing stricter supervisory measures regarding drug development, costs pricing, and information disclosure, driving a need for change to the existing marketing model. In response, medical product manufacturers need reliable partners with both channel capabilities and professionalism to provide insights.

INDUSTRY OVERVIEW

- (iii) ***Low operational efficiency of medical data applications.*** There are various weaknesses in the application of medical data, including a) ways to ensure the quality of data given the huge treasure trove of data available; b) difficulties in achieving standardization as there is no unified standard for collection and monitoring of data; and c) technical processing capabilities.

Internet+ refers to the application of the internet and other information technology in conventional industries, such as medical services and healthcare. This is expected to help improve efficiency of the entire industry and to address its current challenges. Coupled with the promotion of China's medical reform, the Chinese government has been encouraging the expansion of digital medical services as well as the reform and linkage of medical insurance, healthcare and drug circulation systems. Currently, various departments operate independently in these areas and linking them will help to solve the problem of fragmented policies.

Current digital penetration rate of the healthcare industry in China is low (4.6%) and is expected to increase to 21.1% by 2030

The digital penetration rate, referring to the ratio of China's digital healthcare, or healthcare with a digital element, market size relative to China's overall medical and health expenditure is expected to grow with the advancement of technology, standardization and explosive growth in data and its accumulation, and support of macro policies and market demand. According to iResearch, China's digital healthcare market will reach RMB3,055 billion in 2030 and the digital penetration rate is expected to increase to 11.8% in 2025 and 21.1% by 2030.

INDUSTRY OVERVIEW

Favorable policies to encourage digitalization development

The PRC Government supports healthcare big data and drives market development through the policies set forth in the following table:

Policies Related to China's Healthcare Big Data (2015-2021)

Issuance Time	Issuance Authorities	Policy	Content
Feb. 2015	General Office of the State Council	Guiding Opinions on Improving the Centralized Procurement of Drugs in Public Hospitals	Clarified the policy for the implementation of classified procurement of drugs, and put forward detailed guidelines for the centralized procurement of drugs in public hospitals. The implementation is still based on the platforms of various provinces, municipalities and autonomous regions
Aug. 2015	General Office of the State Council	Big Data Development Platform	Develop big data on healthcare services and build comprehensive healthcare service applications
Apr. 2016	General Office of the State Council	Notice on Issuing the Key Tasks for Deepening the Reform of the Medical and Health System in 2016	It is clear that the patient can choose to purchase prescription drugs at the outpatient pharmacies of hospitals or in retail pharmacies with a prescription. Encourage the development of chain pharmacies and promote the separation of medicines and treatments
July, 2016	General Office of the State Council	Healthy China 2030 Platform	Accelerate the development of healthcare big data application system and promote the opening up of healthcare big data based on regional population healthcare information platforms
Sept. 2018	National Health Commission	National Healthcare Big Data Standards, Safety and Service Management Measures (Trial)	Clarify the definition, connotation and extension of healthcare big data, as well as the purpose and basis, scope of application, principles to follow and overall thinking of the formulation of the measures, clarify the scope of duties, rights and responsibilities of health administration departments at all levels, as well as the corresponding rights and responsibilities of all types of medical and health institutions at all levels and their application units so as to standardize the three aspects
Nov. 2018	National Health Commission National Administration of Traditional Chinese Medicine	Opinions on Accelerating the High-quality Development of Pharmaceutical Services	Promote and implement hierarchical diagnosis and treatment, the transformation of pharmaceutical services, the promotion of rational drug use, and the "Internet +" pharmaceutical services
Jan. 2019	General Office of the State Council	Pilot Program of the Centralized Procurement and Use of Drugs Organized by the State	Officially implemented the mass procurement of 33 varieties in 11 pilot cities of "4+7", and expanded the scope of centralized procurement of these 33 varieties to the whole country in the second batch of mass procurement. So far, five batches of mass procurement have been implemented, involving 237 varieties
Jan. 2019	National Medical Products Administration	Measures for the Supervision and Administration of Online Drug Sales	Allow tripartite platforms to sell drugs to individual consumers; allow the sale of prescription drugs to individual consumers via the Internet; allow single pharmacies to sell drugs via the Internet; allow the publication of prescription drug information to individual consumer drug websites
Mar. 2021	28 departments including the National Development and Reform Commission	Implementation Plan for Accelerating the Cultivation of New Types of Consumption	Improve the design of technical routes and strengthen integrated online and offline supervision. Exploring the interconnection of prescription information of medical institutions and drug retail consumption information and promoting the development of drug network sales standards

Source: General Office of the State Council, National Health Commission, National Development and Reform Commission, etc.; iResearch

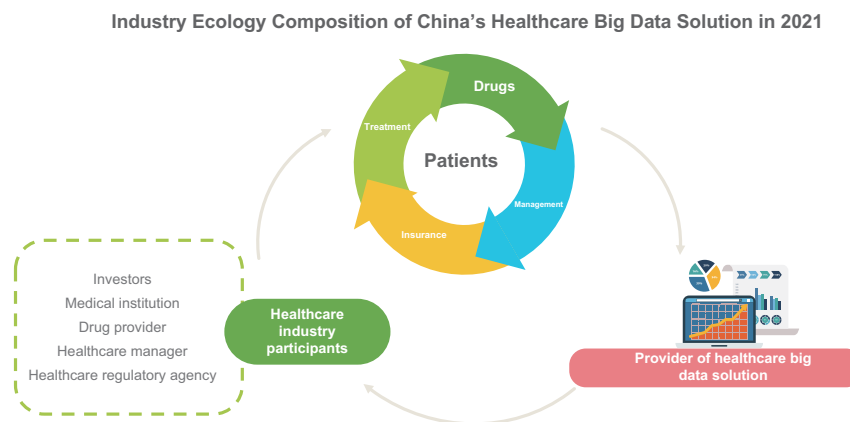
INDUSTRY OVERVIEW

In particular, the Healthy China 2030 Platform policy issued in July 2016 and the National Healthcare Big Data Standards, Safety and Service Management Measures issued in September 2018 were beneficial to companies with healthcare big data application systems, with the latter setting out definitions and connotations of healthcare big data, as well as scope of application and principles to follow. Healthcare big data is the sum of data from medical treatment, life, and health. Consequently, it includes the sum of data generated during prevention, treatment, and care. The Pilot Program of the Centralized Procurement and Use of Drugs Organized by the State issued in January 2019 officially expanded the scope of centralized procurement of drugs. The Measures for the Supervision and Administration of Online Drug Sales issued in January 2019 allowed, among other things, the sale of prescription drugs to individual consumers via the internet and the publication of prescription drug information to individual consumer drug websites.

HEALTHCARE BIG DATA SOLUTIONS INDUSTRY

Ecosystem of China's healthcare big data solutions industry and its participants

After years of development, China's healthcare industry has formed a patient-oriented ecosystem, which provides patients with services such as medical treatment, medication, insurance payment, and healthcare management. Healthcare big data solutions can provide better services for investors, medical institutions, drug providers, healthcare managers, healthcare regulators, insurance institutions and patients in the medical industry chain, including reducing clinical research and development costs, enhancing the quality of hospital diagnosis and treatment services, and improving the efficiency of institutional management and operation, which in turn can create great value for China's healthcare industry chain. The following diagram shows this industry ecosystem in 2021:



Source: *iResearch Report*

INDUSTRY OVERVIEW

Competitive landscape of China's healthcare big data solutions

Healthcare big data solutions are created to support the informatization, digitization and intelligentization needs of various organizations, institutions and enterprises in the healthcare industry. The healthcare big data solutions market can be divided based on data application scenarios into the following three types of competitors:

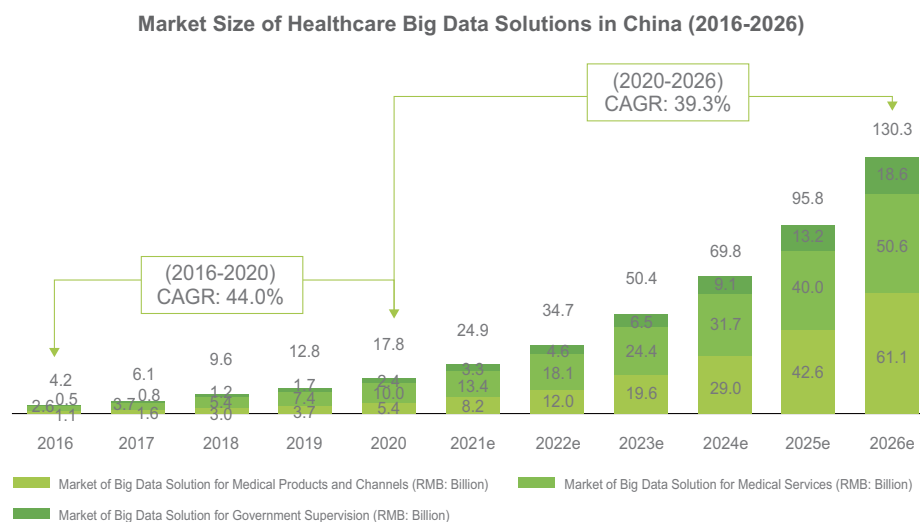
- (i) **Market for big data solutions for medical products and channels.** Companies in the market of big data solutions for medical products and channels provide solutions, such as real-world study (RWS) of medical products, data insight solutions, and pharmaceutical SaaS services, to all kinds of institutions and companies, mainly being medical product manufacturers including (a) pharmaceutical companies, (b) medical equipment companies and (c) healthcare product manufacturers, and pharmaceutical distributors, based on big data of (1) users' purchasing behavior regarding medicines and medical equipment and (2) medicines and medical equipment distribution channels. In 2020, this segment accounted for approximately 30.3% of the entire healthcare big data solutions market and there are currently approximately 800 to 1,000 players.
- (ii) **Market for big data solutions for medical services.** Companies in the market of big data solutions for medical services provide solutions, such as smart medical services (e.g., clinical decision support system (CDSS)), electronic medical records, and medical imaging, mainly to hospitals, clinics and other medical institutions, based on healthcare big data generated through the interaction between doctors and patients during provision of medical services. In 2020, this segment accounted for approximately 56.2% of the entire healthcare big data solutions market and there are currently approximately 1,500 to 1,600 players.
- (iii) **Market for big data solutions for government supervision.** Companies in the market of big data solutions for government supervision provide services, such as policy-making support and regional epidemiological research services, to governments and regulatory departments, based on the healthcare data generated through government supervision on medical activities. In 2020, this segment accounted for approximately 13.5% of the entire healthcare big data solutions market and there are currently fewer than 200 players.

INDUSTRY OVERVIEW

China's healthcare big data solutions market is relatively fragmented, and currently, concentration in the industry is relatively low and expected to increase in the future. Players in the healthcare big data solutions market may operate in one or more segments and the approximate number of players in each segment are estimates only. One of the main differences between these companies are the sources of their data, which may include clinical data, data from medical channels, non-medical channels, or health management platforms. Solutions and products offered by these companies also vary from market reports, consulting services, sales and marketing strategies, and scientific research plans, among other deliverables. Healthcare big data solutions may also be largely categorized into marketing oriented solutions and research and development oriented solutions with different purpose and applications. Marketing oriented solutions are generally targeted towards the sales and marketing functions of medical product manufacturers. For example, products like market insights are valuable to such clients who need to be aware of market trends or require precision marketing services. Research and development oriented solutions generally serve research and development functions of medical product manufacturers, medical service providers and governments. For example, solutions like RWS, CDSS and electronic medical records support development and innovation of medical products as well as research abilities of medical services. Pathology research solutions are also used by governments to conduct research on health conditions and related policies.

Market size of healthcare big data solutions in China

Driven by advanced technologies such as AI and cloud computing, China's healthcare big data solutions market grew rapidly and steadily with over 2,500 players as at 31 December 2020, and its market size reaching RMB17.8 billion in 2020. According to iResearch, the CAGR of the healthcare big data solutions market from 2020 to 2026 will reach 39.3%, with the market size reaching RMB130.3 billion by 2026. The following chart shows the market size and forecast of healthcare big data solutions in China from 2016 to 2026:

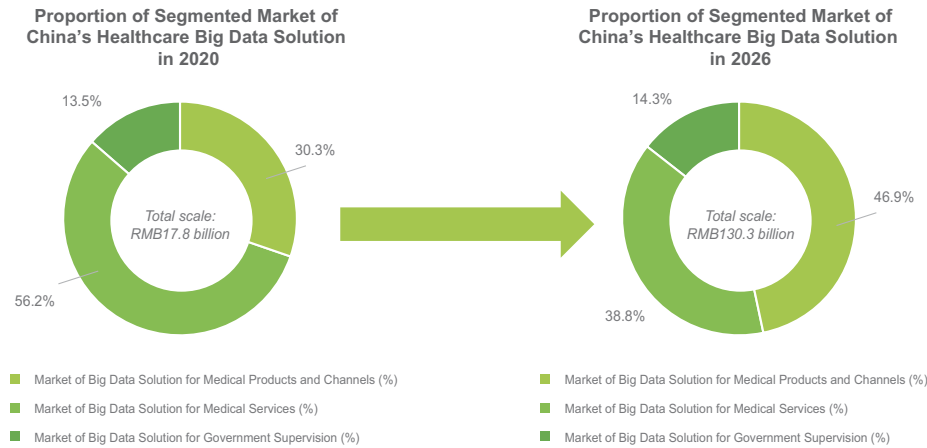


Source: Ministry of Commerce, National Health Commission, "2020 China Health Statistics Yearbook", etc.; iResearch

INDUSTRY OVERVIEW

Medical products and channels segment enjoys the highest growth potential

Currently, the market of big data solutions for medical services is the largest, followed by the market of big data solutions for medical products and channels. According to iResearch, the market of big data solutions for medical products and channels will become the largest in 2026, accounting for 46.9% of the entire market of China's healthcare big data solutions. The following charts show the forecasted growth in the proportion of segmented market of China's healthcare big data solutions from 2020 to 2026:

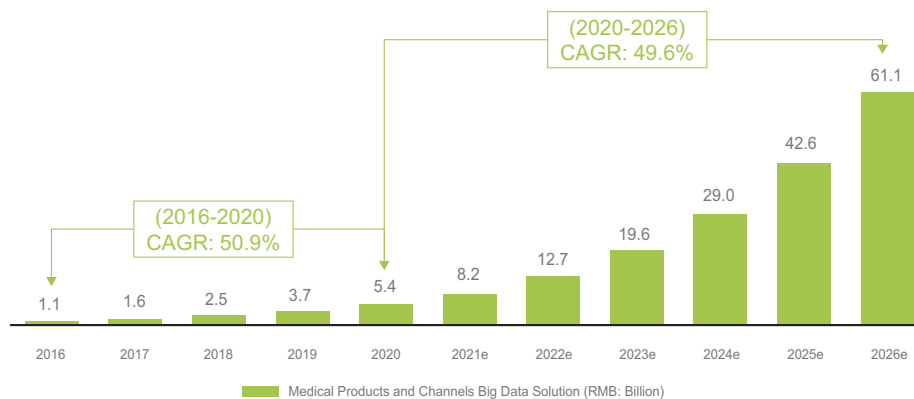


Source: Ministry of Commerce, National Health Commission, "2020 China Health Statistics Yearbook", etc.; iResearch

Medical products and channels segment and its drivers

Driven by factors such as the pressure of pharmaceutical research and development, marketing transformation pressure and the COVID-19 pandemic, the market of big data solutions for medical products and channels has grown rapidly, reaching RMB5.4 billion in 2020. According to iResearch, the market of big data solutions for medical products and channels will have a CAGR of 49.6% from 2020 to 2026, at which time the market size will reach RMB61.1 billion. The following chart shows the market size and forecast of big data solutions for China's medical products and channels from 2016 to 2026:

Market Size of Big Data Solution for China's Medical Products and Channels (2016-2026)



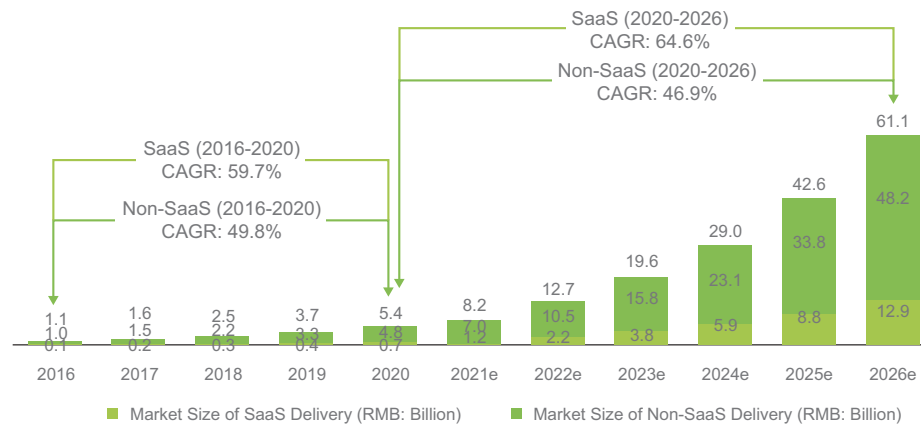
Source: Ministry of Commerce, National Health Commission, "2020 China Health Statistics Yearbook", etc.; iResearch

INDUSTRY OVERVIEW

Medical products and channels

The market of healthcare big data solutions for medical products and channels can be divided into two delivery models: SaaS delivery and non-SaaS delivery. SaaS (software as a service) refers to a delivery model where the final service or software is provided directly to end users where the computing and data storage required for such services do not require local storage and instead are hosted externally. In 2020, the market size of SaaS delivery was RMB0.7 billion while the market size of non-SaaS delivery was RMB4.8 billion. The market size of SaaS delivery will grow much faster than non-SaaS delivery in the future. The following chart shows the market size and forecast of the two delivery models from 2016 to 2026:

Delivery Models of Big Data Solution for China's Medical Products and Channels (2016-2026)



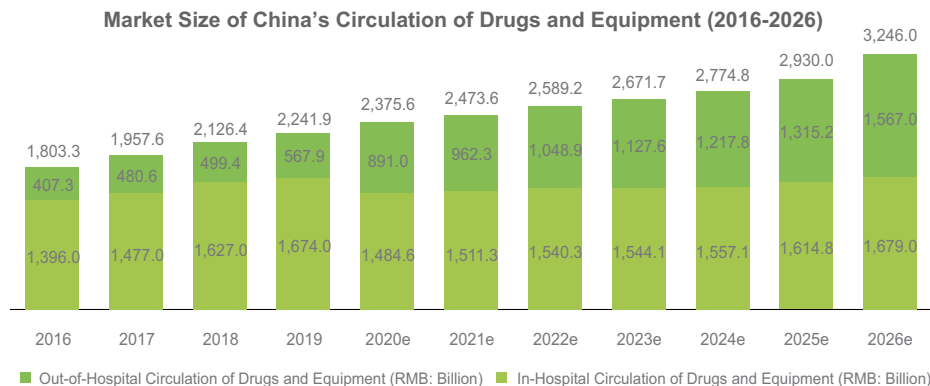
Source: National Health Commission, "2020 China Health Statistics Yearbook", "2020 Cloud Computing Development White Paper" released by the China Academy of Information and Communications Technology (CAICT), etc.; iResearch

The SaaS delivery model has many advantage when compared to traditional software models, such as fast deployment, flexible payment methods, and low operation and maintenance costs. According to the iResearch Report, the SaaS delivery model will become more prevalent as technologies advance. These advantages in delivery, operation and maintenance are important in many industries, and the SaaS delivery model is expected to have a broader application prospect in the medical and healthcare industry. It is characterized by being flexible to use, capable of updating data on a timely basis, convenient to operate and relatively cost-effective. As such, medical product manufacturers and healthcare companies will consider adopting SaaS products more often to solve their marketing and operation problems, and healthcare big data solutions delivered by SaaS products are expected to become more popular. In 2020, approximately 12.0% of big data solutions for medical products and channels in China used the SaaS delivery method and iResearch estimates this to reach approximately 22.0% by 2026, and thus SaaS delivery capabilities will also become one of the more important competencies of companies in the industry.

INDUSTRY OVERVIEW

Development of circulation of medicine outside of hospitals

Previously, the predominant market for distribution of pharmaceuticals had always been in hospitals. However, with certain reforms in 2016 encouraging development of chain pharmacies and the introduction of the prescription outflow policy at the end of 2019, electronic prescription information sharing platforms were established in certain provincial hospitals. Prescription outflow refers to prescriptions by doctors flowing from being mainly within hospitals to outside hospitals and online, and where patients could choose to pick up their medicines from their preferred pharmacies. The supported medicines of prescription outflow in the early stage included medicines for common illnesses, chronic diseases and cancer. According to iResearch, driven by the prescription outflow policy, the market size of out-of-hospital circulation of medicines and equipment will gradually increase. However, the growth trend will mainly depend on the local governments' efforts in the implementation and promotion of the policy and the operational capabilities of out-of-hospital pharmacies. The following chart shows the market size and forecast of China's circulation of drug and equipment from 2016 to 2026:



Source: National Health Commission, National Medical Products Administration, etc.; iResearch

Increasing number of chain pharmacies pushes up the investment in digitalization

According to data from the National Medical Products Administration of the PRC, the number of chain retail pharmacies in China had increased year by year. In 2020, the total number of retail pharmacy stores in China, which refers to the number of actual stores, was approximately 554,000, and approximately 55.7% of which were chain pharmacies. Chain pharmacies refer to those which have 10 or more retail stores. According to iResearch, under the impact of online pharmaceutical business and related policies, the percentage of chain pharmacies will further increase and reach approximately 71.7% by 2026. Additionally, compared with individual pharmacies, chain pharmacies have greater requirements for application of information technology. With the increase in chain pharmacies, the demand for application of information technology by retail pharmacies will also increase.

INDUSTRY OVERVIEW

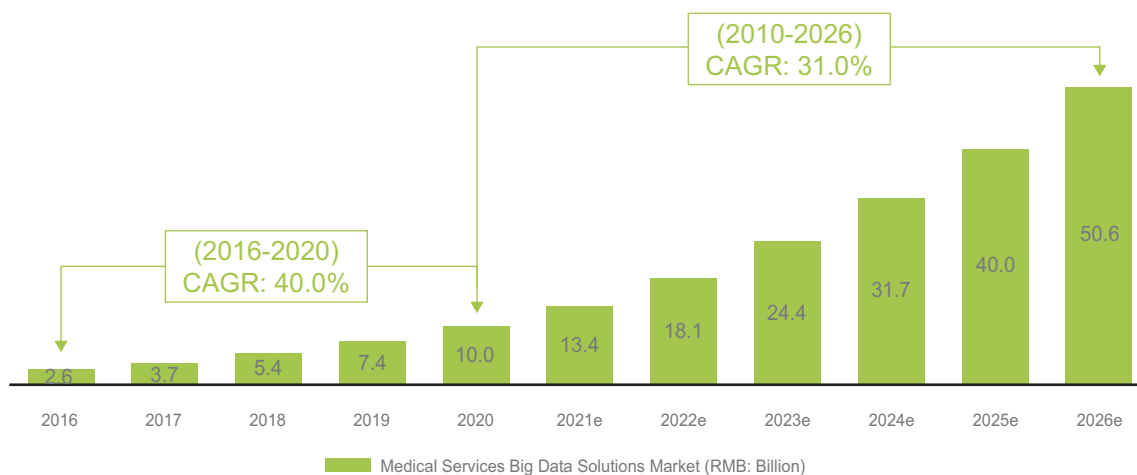
Medical services segment

Big data solutions for medical services refers to big data solutions created based on the big data generated through medical services and are provided to institutions such as hospitals and clinics. The business mainly includes: (1) clinical trial related services (contract research organization (CRO) research and development assistance, clinical trial optimization, etc.); and (2) smart medical-related services (clinical decision support system (CDSS), smart medical records management, hospital management system, etc.).

During the pre-clinical research and development stage, medical product manufacturers can leverage big data and AI technology to explore drug targets and screen compounds more efficiently. In the subsequent new drug research and development stage, big data modeling and analysis can be used to determine the most effective input-output ratio, plan more efficient clinical research arrangements, and thus allocate the best combination of resources. In addition to reducing research and development costs, contract research organization (CRO) new drug research and development solutions can also help medical product manufacturers shorten the cycles of clinical trials and return on investment. Additionally, medical product manufacturers can bring drugs to market faster, produce more targeted drugs, and achieve higher potential market returns and treatment success rates.

The market size of big data solutions for medical services in China reached RMB10.0 billion in 2020. According to iResearch, as healthcare big data is increasingly recognized by medical institutions and clinics, healthcare big data solutions will be implemented in more hospitals and other medical institutions and companies from 2020 to 2026, and the market size will reach RMB50.6 billion in 2026. The following chart shows the market size and forecast of big data solutions for medical services in China from 2016 to 2026:

Market Size of Big Data Solutions for Medical Services in China (2016-2026)



Source: National Health Commission, "China Health Statistics Yearbook 2020", etc.; iResearch

INDUSTRY OVERVIEW

Historical price trends

Within the healthcare big data solutions industry, there are generally two pricing models used by industry players:

Model A Data is mainly obtained from medical records directly from the hospital, and the price depends on the year of data generation, hospital level and the number of medical records. The price trend increased from approximately RMB100,000 in 2015 to approximately RMB200,000 in 2020 per healthcare big data solutions project.

Model B Data mainly comes from medical literature and sales data, which includes basic data that can be provided to partnering companies for medical research and product marketing. After desensitization, the data is used to prepare research reports and strategic analysis for partnering companies. The price trend increased from RMB200,000 in 2015 to RMB500,000 in 2020 per healthcare big data solutions project.

Competition

Typical enterprises in China’s healthcare big data solutions industry include companies which provide big data solutions for medical products and channels. Among these companies, we have and are able to obtain big data relating to medical products and channels and also from a large number of medical product manufacturers. The current industry concentration is relatively low and is expected to increase in the future, which will benefit the industry-leading enterprises with competitive advantages. The market size of healthcare big data solutions in 2020 is RMB17.8 billion. The top companies in China’s overall healthcare big data solutions market based on revenue in 2020 are:

Ranking	Companies	Company description	Revenue ⁽¹⁾ (RMB in million) 2020
1	Company D	A service provider of healthcare big data solutions listed on the Stock Exchange mainly focusing on medical research, medical management, government public decision-making and regulations	430
2	Company E	A service provider of healthcare big data solutions mainly focusing on research and development for hospitals and public health, clinical diagnosis, scientific research services, and insurance innovation	400
3	Company F	A healthcare big data solutions provider that connects residents, doctors, hospitals, medicine, health management, and medical care integration	380

INDUSTRY OVERVIEW

Ranking	Companies	Company description	Revenue ⁽¹⁾ (RMB in million) 2020
4	Company A	A pharmaceutical healthcare big data solutions service provider connecting doctors, patients and medical equipment companies	350
5	Company G	A hospital research and development solutions provider mainly for hospitals, implemented with AI and healthcare big data	260
6	Company H	A healthcare big data solutions provider mainly for the drug development process	220
7	Company B	A service provider of healthcare big data solutions for medical products and channels mainly based on patient insights	210
8	The Company (Sinohealth)	A healthcare big data solutions provider mainly for medical products and channels	202
9	Company I	A healthcare big data solutions provider mainly for pharmaceutical and medical device companies and physicians listed on the Stock Exchange	160
10	Company J	A healthcare big data solutions provider that supports clinical genetic testing businesses	110

Notes:

- (1) Revenue refers to that generated by each company from healthcare big data solutions business.
- (2) Unless otherwise specified, companies are unlisted.

According to iResearch, we are ranked no. 8 with a market share of 1.1%. According to iResearch, the current average profitability level of the healthcare big data industry is a net profit margin of approximately -2% to 5%. We have a profitability level, or net profit margin, of more than 30% for 2018, 2019, and 2020, which is much higher than the current industry average and enjoy a competitive advantage due to our coverage of the largest number of top medical product manufacturers, solid technological capabilities and multi-disciplinary talents.

INDUSTRY OVERVIEW

No.1 in medical products and channels segment by revenue

In 2020, the market size of big data solutions for medical products and channels was RMB5.4 billion. We ranked No. 1 among all healthcare big data solutions providers for medical products and channels in terms of revenue in 2020 with a market share of 3.7%, according to the iResearch Report. The following table shows the top five enterprises in China's healthcare big data solutions market for medical products and channels in terms of revenue in 2020:

Ranking	Companies	Company description	Revenue ⁽¹⁾ (RMB in million) 2020	Market share (%)
1	The Company (Sinohealth)	A service provider of healthcare big data solutions for medical products and channels	202	3.7
2	Company A	A pharmaceutical healthcare big data solutions service provider connecting doctors, patients and medical equipment companies	168	3.1
3	Company I	A healthcare big data solutions provider mainly for pharmaceutical and medical device companies and physicians listed on the Stock Exchange	160	2.9
4	Company B	A service provider of healthcare big data solutions for medical products and channels mainly based on patient insights	156	2.9
5	Company D	A service provider of healthcare big data solutions listed on the Stock Exchange mainly focusing on medical research, medical management, government public decision-making, services and regulations	132	2.4

Source: iResearch Report

Notes:

(1) Revenue refers to that generated by each company from big data solutions for medical products and channels.

(2) Unless otherwise specified, companies are unlisted.

INDUSTRY OVERVIEW

No.1 in medical products and channels segment by number of top medical product manufacturers under coverage

The following table shows the top five enterprises in China's healthcare big data solutions market for medical products and channels in terms of the number of top medical product manufacturers⁽¹⁾ covered in 2020:

Ranking	Companies	Company description	Number of top medical product manufacturers covered ⁽¹⁾
1	The Company (Sinohealth)	A healthcare big data solutions provider mainly for medical products and channels	57
2	Company I	A healthcare big data solutions provider mainly for pharmaceutical and medical device companies and physicians listed on the Stock Exchange	55
3	Company A	A pharmaceutical healthcare big data solutions service provider connecting doctors, patients and medical equipment companies	40
4	Company C	A healthcare big data solutions provider for non-medical companies	32
5	Company D	A service provider of healthcare big data solutions listed on the Stock Exchange mainly focusing on medical research, medical management, government public decision-making, services and regulations	30

Source: iResearch Report

Notes:

- (1) Top medical product manufacturers refer to the top 100 global medical product manufacturers from Torreya in 2020 and the top 115 Chinese medical product manufacturers from yaozh.com in 2020.
- (2) Unless otherwise specified, companies are unlisted.

Entry barriers

Through years of development, a number of high-quality big data solutions providers have emerged in China's healthcare big data solutions industry, while at the same time, the industry has established higher barriers of entry, making it difficult for new entrants to succeed if they do not invest large amounts of resources or have a clear profit model. iResearch believes that the industry threshold is high, which requires time investment and a complete industry chain. In the current big data solutions industry, companies with first mover advantage, talents in technical disciplines and big data processing technology will be more competitive in the industry.

First mover advantage

Early players in the industry will have accumulated more data, more project experience and possess a more complete industry chain. Taking advantage of established brands, solid user foundations and technology and marketing resources, they will have more advantages in attracting users and building resource-based platforms. The deeper data accumulation advantage is a barrier that is difficult to surpass in the field of big data.

INDUSTRY OVERVIEW

Talents in technical disciplines

Regarding technical operation and business development, the healthcare big data solutions industry requires the support of multi-disciplinary professional talents who are familiar with innovative technologies such as big data, artificial intelligence, machine learning and cloud computing as well as the medical field in order to connect the medical industry with information systems. Latecomers in the industry need to invest a lot of time and resources to cultivate such multi-disciplinary talents.

Big data processing technology

Diversified solutions for different big data application scenarios of enterprises are determined by the ability to standardize and manage data, and the ability to handle multi-dimensional data through artificial intelligence.

Challenges of the healthcare big data industry

The healthcare big data industry faces challenges including (i) data standards; (ii) data management; (iii) data security; (iv) data quality; and (v) data application.

- (i) ***Data standards*** – The data standards from different data sets are different, and the sharing between data sets is more complex, which leads to the inconsistency of the collected medical big data standards.
- (ii) ***Data management*** – There are many kinds of databases, and the data sharing mechanism is not perfect, and there is no way to ensure the efficient management of data sets.
- (iii) ***Data security*** – With the application of healthcare big data, users cannot ensure the absolute security and privacy of data application. It is difficult to quantify the risk, because information leakage may occur at any stage from data creation to its usage.
- (iv) ***Data quality*** – Poor quality of healthcare data has a great impact on machine learning algorithms, which will greatly affect the accuracy of future algorithms and models. As most of the big data comes from the real world, there will undoubtedly be lost and incomplete data, which need to be adjusted at the technical level.
- (v) ***Data application*** – During the process of applying data in the healthcare field, due to its specialized nature, particular analytical method libraries, mining algorithm libraries, and model libraries are required, which are currently lacking.

Future Trends and Opportunities

Potential in out-of-hospital market for data collection

On one hand, healthcare big data solutions companies need to continuously carry out data collection and standardization, and generate more accurate, scientific and effective solutions based on massive data. On the other hand, they also need to improve their own data access

INDUSTRY OVERVIEW

capabilities, and integrate previously isolated data from different sources in order to expand the service scopes of healthcare big data solutions. There are still many difficulties when it comes to connecting in-hospital data with out-of-hospital data, such as technical integration and privacy protection. Thus, the focus in the near future will be on exploring how in-hospital data and out-of-hospital data can be independently applied in different scenarios. Compared with in-hospital data, out-of-hospital data is easier to obtain and involves less private data. The applications of out-of-hospital data will become more diversified, thereby having huge market potential.

Integration of big data and medical services to promote the development of internet hospitals

The establishment and operation of internet hospitals are inseparable from the support of information technology, and the collection and sharing of in-hospital medical big data is the core part of internet hospitals. Internet hospitals refer to one-stop service platforms based on physical hospitals, with a focus on follow-up visits and routine consultations, and integrating consultation, prescription, payment and drug delivery. In addition, as the hospital information system generates a huge amount of in-hospital big data, the value of this data can be realized through the use of data mining and analysis capabilities of AI and big data technology. Therefore, the market of big data solutions for medical services represented by internet hospitals is also expected to have good prospects in the future.

Popularity for SaaS delivery

The SaaS model has demonstrated great advantages, such as delivery, operation and maintenance, in many industries. With the development and technological progress of proprietary cloud, hybrid cloud and other deployment models, data privacy protection and other issues will be effectively solved, and SaaS will have broader application prospects in the healthcare industry. Due to the advantages of SaaS, such as flexible use, timely data update, convenient operation and relatively low cost, pharmaceutical and consumer healthcare enterprises will consider using SaaS more often to solve their marketing and operational problems in the future. Therefore, healthcare big data solutions delivered using SaaS will become more popular.

Potential in the value of healthcare aPaaS

In comparison to SaaS, which provides users directly with software as a service, aPaaS provides users with a platform or building capabilities as a service. Healthcare aPaaS service provides a visual application development environment for developers or users, reducing or eliminating the need for native code writing, so as to achieve a convenient solution to build applications. The values of healthcare aPaaS for healthcare companies include: (i) the rapid development and deployment of software which can be realized through the output reusable model, leading to shortened project lead times; (ii) through the healthcare aPaaS development platform, users can significantly increase their own capabilities, such that they do not need to outsource the development work or set up their own software research and development team and can reduce their research and development costs; and (iii) through convenient reading and writing data, combined with workflow capabilities, the healthcare aPaaS platform can connect the data required by the core businesses and break down the data silos. Therefore, healthcare aPaaS will usher in a period of rapid development, and the market size is expected to increase year by year.

INDUSTRY OVERVIEW

Closed-loop ecosystem targeting whole-cycle integrated solutions

With the gradual development of the healthcare industry, its weakness has become increasingly obvious. The simple online consultation and online purchase of medicine cannot solve the real needs of patients. Patients still have doubts about how to proceed with the next steps in their diagnosis and treatments. Healthcare big data has inherent advantages in enabling the entire ecosystem. Through merging the upstream payment, diagnosis and treatment from the original medical treatment chain with the downstream management and check-up reminder, a complete closed-loop ecosystem is formed. This can increase patients' compliance in taking medicine, as well as assessing the real needs of healthcare users, thereby making adjustments to facilitate the overall rapid and healthy development of the healthcare industry.

Further commercialization opportunities to enable healthcare management and commercial insurance

For healthy individuals, it is very important to carry out healthcare management through the support of primary healthcare and hygiene and healthcare big data can support such needs. The healthcare big database can quickly arrange for a healthy person who becomes ill to enter into the primary healthcare system, and provide his/her regular detailed healthcare information to assist with the implementation of diagnosis and treatment.

It is through using emerging technologies such as mobile applications, big data, cloud computing and artificial intelligence that insurance technology can fully assess user preferences and risks, among other things, in order to design and match the most suitable insurance products for clients, transform the extensive development pattern of the traditional insurance industry and optimize user experience. In the future, insurance technology is likely to reshape the insurance industry's value chain system.