AI in Healthcare Market Study

Independent Market Research Report

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For and on behalf of
Frost & Sullivan (Beijing) Inc., Shanghai Branch Co.

Confidential For

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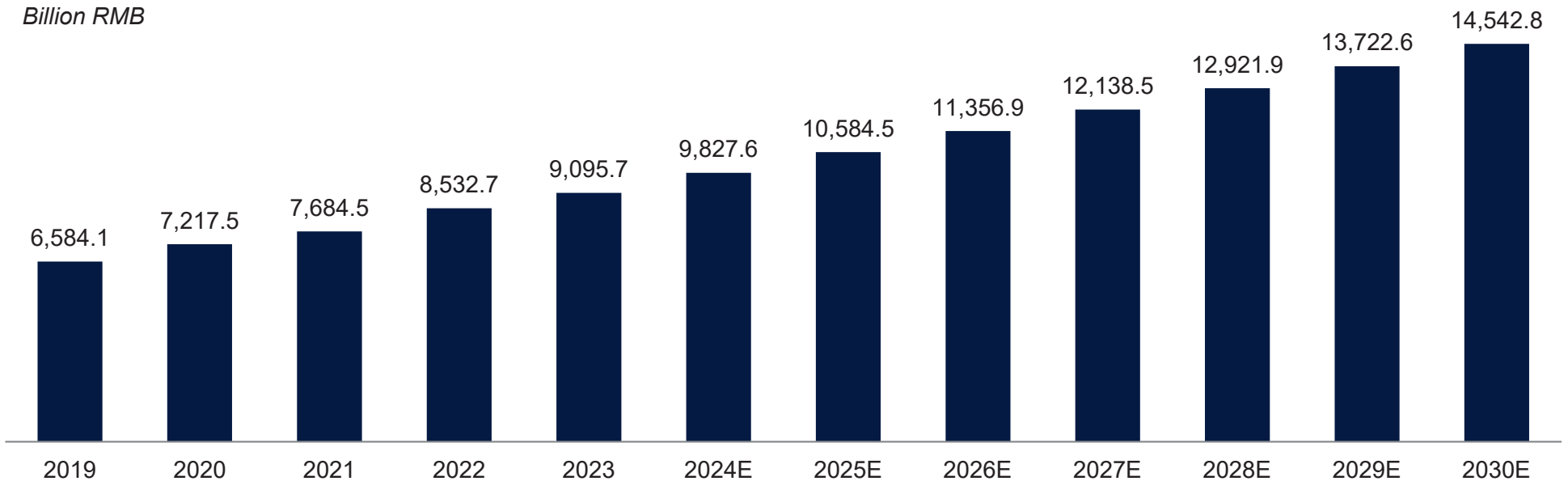
Table of Content

China Healthcare Expenditure, 2019-2030E

- The total healthcare expenditure of China has experienced steady growth. From 2019 to 2023, the total healthcare expenditure of China has increased from RMB 6,584.1 billion to RMB 9,095.7 billion, representing a CAGR of 8.4%. Furthermore, the rapid increasing trend in China's healthcare expenditures will continue in the near future. The total healthcare expenditure of China is forecasted to reach to RMB 14,542.8 billion by 2030, which represents a CAGR of 6.9% from 2023 to 2030.

China Healthcare Expenditure, 2019-2030E

Period	CAGR
2019-2023	8.4%
2023-2030E	6.9%



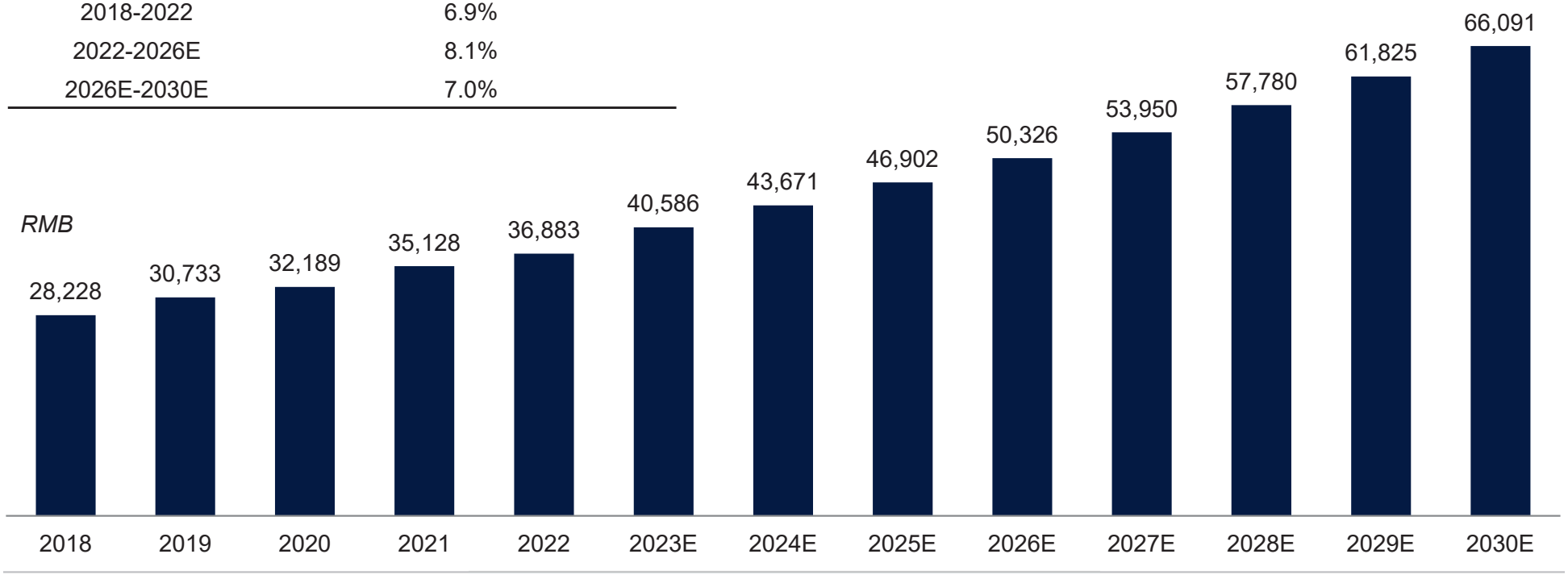
Source: NHC, Frost & Sullivan Analysis

Per Capita Disposable Income in China, 2018-2030E

- Along with the continuous growth in economy and urbanization, the average income level of the Chinese residents has also increased continuously in recent years. From 2018 to 2022, the per capita disposable income has increased from RMB 28,228 to RMB 36,883, representing a CAGR of 6.9%. Frost & Sullivan estimates that by 2026, the per capita disposable income will increase to RMB 50,326, with a CAGR of 8.1% during 2022 to 2026.
- By 2030, disposable income of Chinese residents is expected to grow at a CAGR of 7.0% from 2026 to 2030 and reach RMB 66,091 in 2030.

China Per Capita Disposable Income, 2018-2030E

Period	CAGR
2018-2022	6.9%
2022-2026E	8.1%
2026E-2030E	7.0%



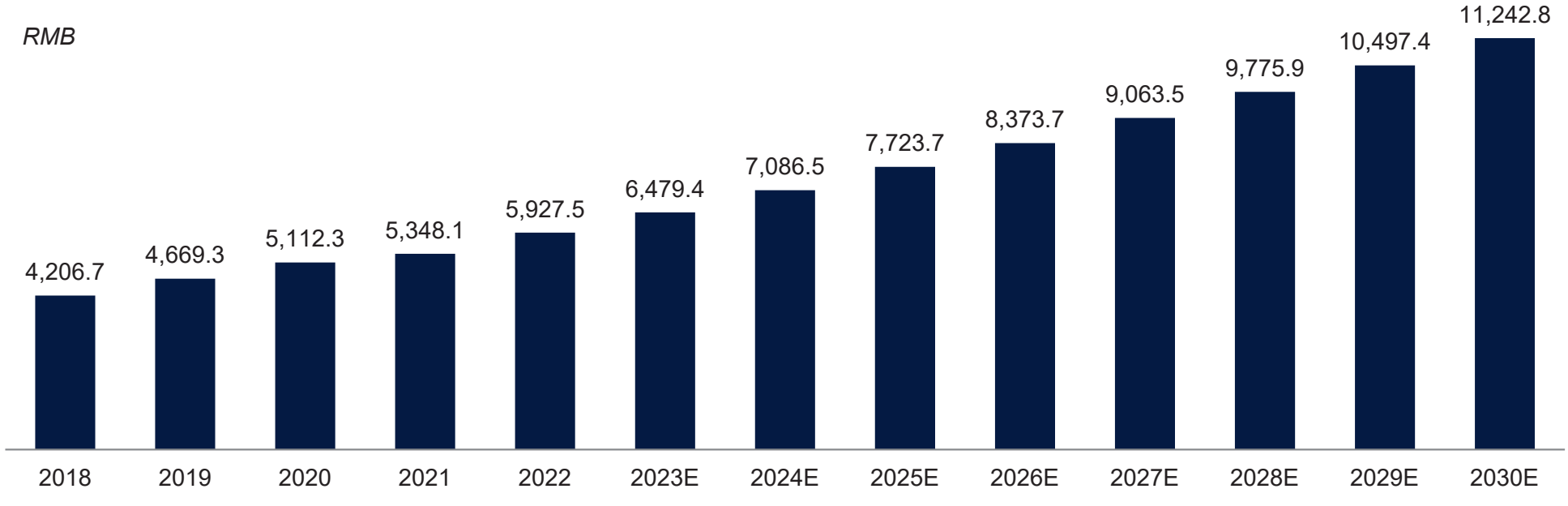
Source: World Bank, Frost & Sullivan Analysis

Per Capita Healthcare Expenditure in China, 2018-2030E

- The per capita healthcare expenditure in China has experienced steady growth. From 2018 to 2022, the per capita healthcare expenditure in China has increased from RMB 4,206.7 to RMB 5,927.5, representing a CAGR of 9.0%. Furthermore, the rapid increasing trend in healthcare expenditure per capita will continue in the near future. The per capita healthcare expenditure in China is forecasted to reach to RMB 8,373.7 by 2026 and to RMB 11,242.8 by 2030, which represents a CAGR of 9.0% from 2022 to 2026, a CAGR of 7.6% from 2026 to 2030.

Per Capita Healthcare Expenditure in China, 2018-2030E

Period	CAGR
2018-2022	9.0%
2022-2026E	9.0%
2026E-2030E	7.6%

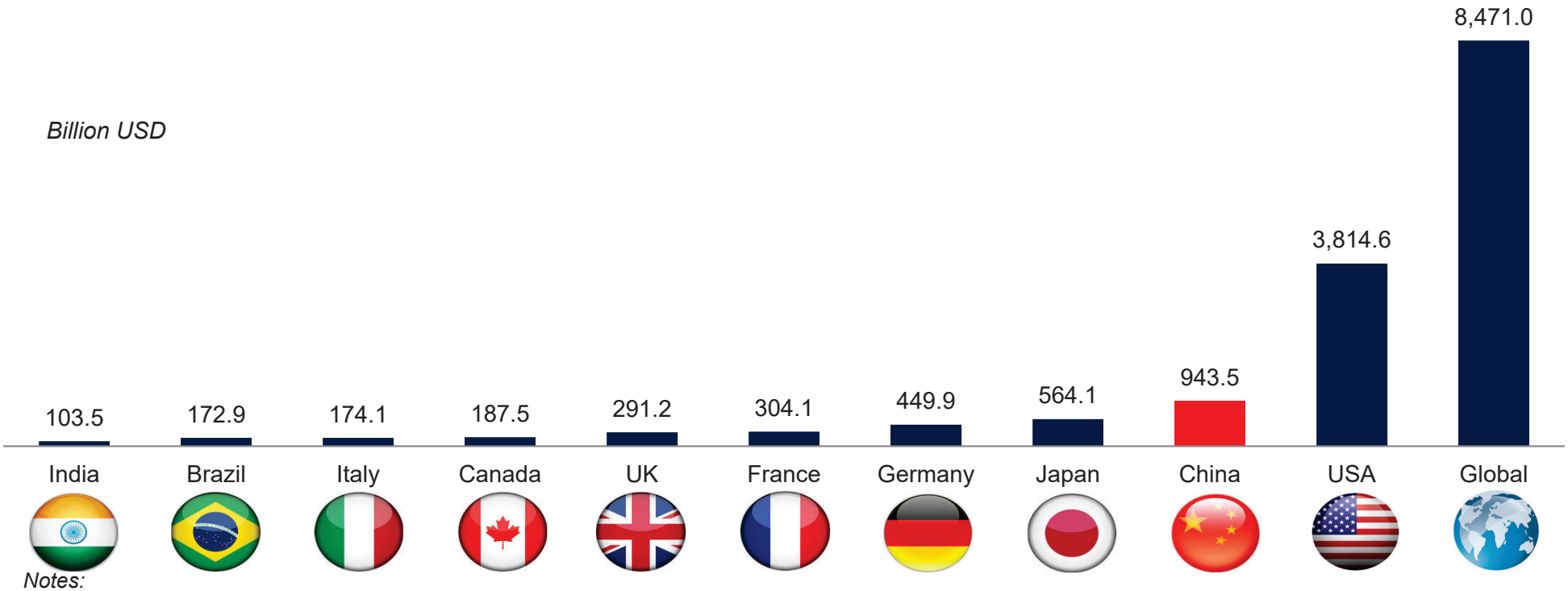


Source: NHC, Frost & Sullivan Analysis

2019 Healthcare Expenditure Comparison, GDP Top 10 Countries

- According to calculations based on information from WHO, the National Bureau of Statistics, OECD, CMS and Frost & Sullivan estimates, China ranked 2nd globally in terms of total healthcare expenditures in 2019. The following chart sets forth the total healthcare expenditures of the 10 countries with the largest GDP in the world in 2019.
- In 2019, China also ranked 2nd globally in terms of total healthcare expenditure, with USA ranked the first in total healthcare expenditure. China is followed by Japan and Germany ranking the 3rd and 4th respectively.

Total Healthcare Expenditure, 2019



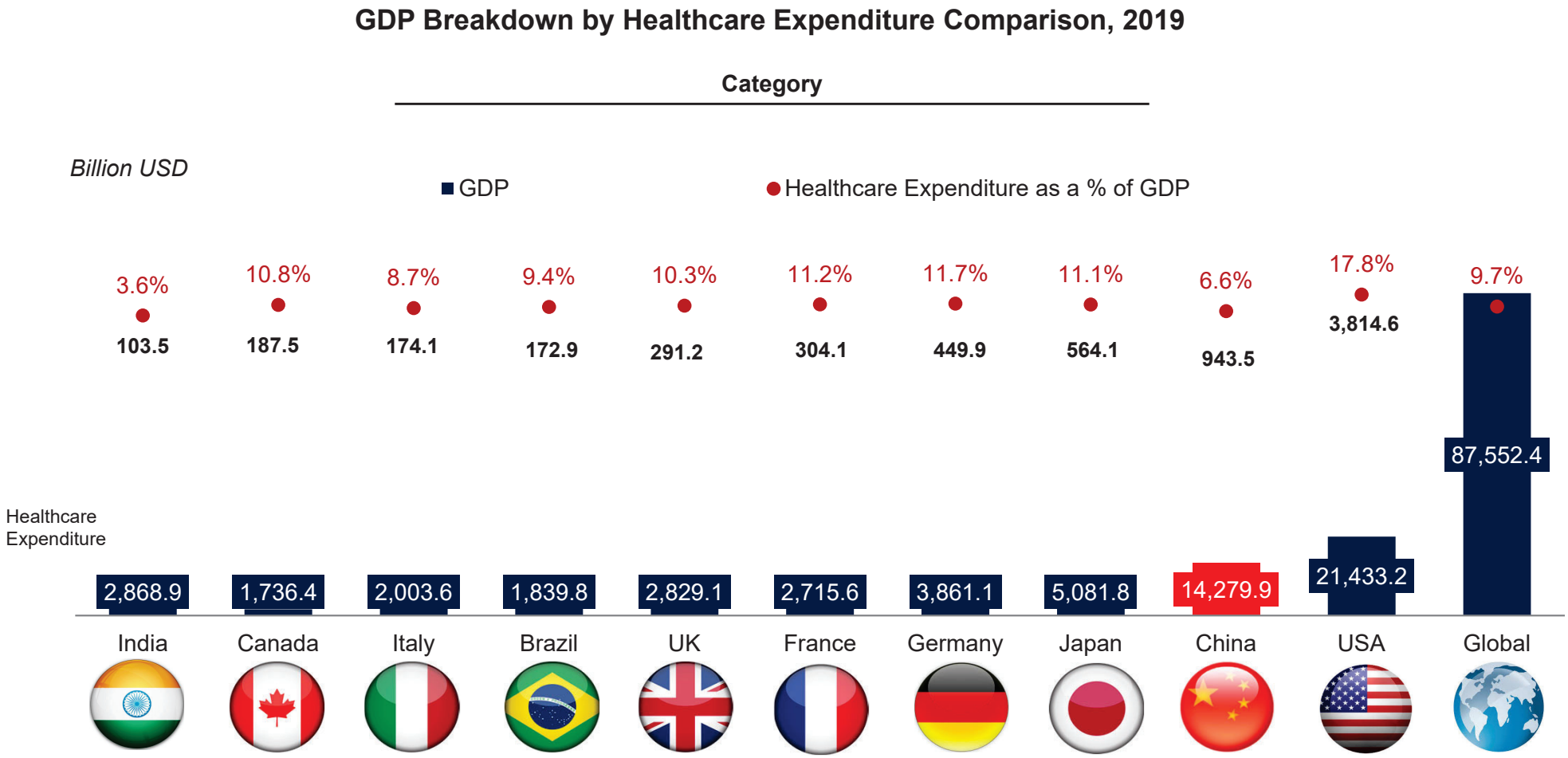
Notes:

- *USD-CNY Yearly Average Exchange Rates: 6.283627 (2015), 6.643058 (2016), 6.756806 (2017), 6.619897 (2018), 6.909792 (2019)*
- *Total Healthcare Expenditure consists of basic medical insurance expenditure, commercial medical insurance expenditure, out-of-pocket health expenditure and other expenditure.*
- *Global healthcare expenditure was reported in 2018*

Source: WHO, NBSC, OECD, Frost & Sullivan Analysis

2019 GDP Breakdown by Healthcare Expenditure Comparison, GDP Top 10 Countries

- The chart below presents the healthcare consumption expenditure and its percentage of GDP among GDP Top 10 countries. The percentages of most countries are around 10%. However, the US has the highest percentage of healthcare expenditure 17.8%. For India and China, the percentages are relatively low, being 3.6% and 6.6% respectively.

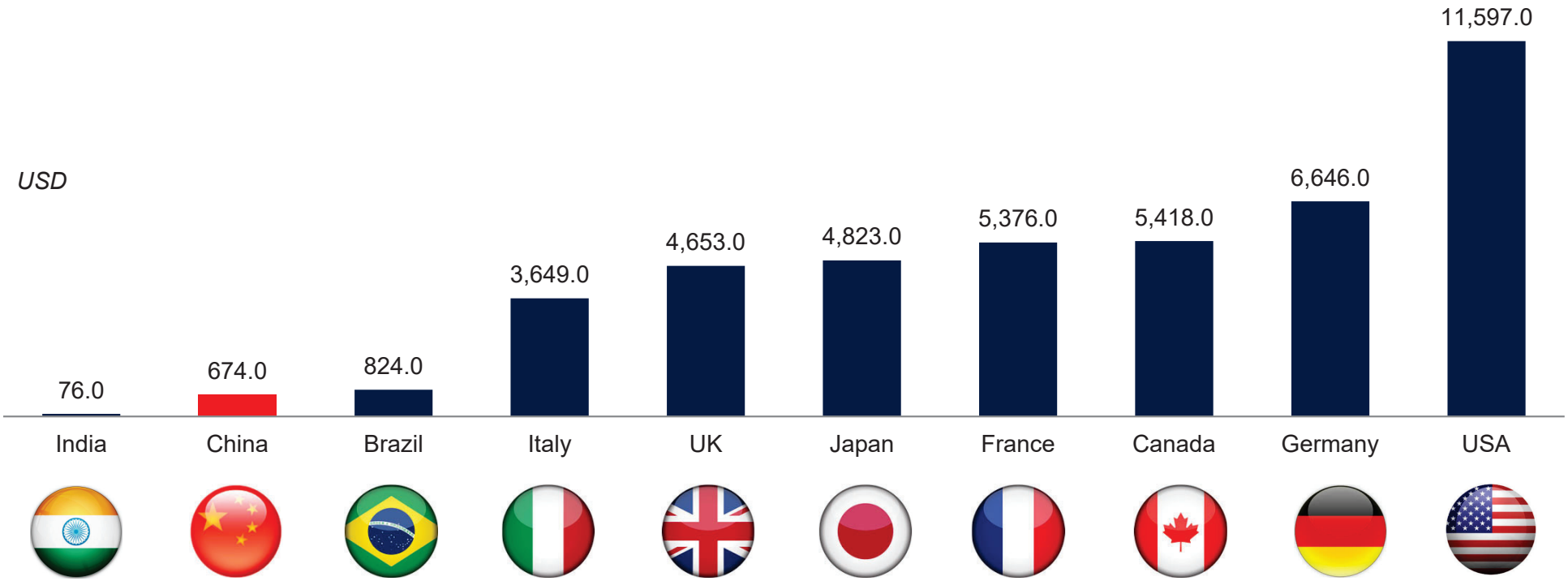


Source: NBSC, BEA, Frost & Sullivan Analysis

2019 Per Capita Healthcare Expenditure Comparison, GDP Top 10 Countries

- In contrast with the total healthcare expenditure, the per capital national healthcare expenditure in China in 2019 ranked 9th in the selected 10 countries, only surpassing that of India. Top 7 countries are developed countries with either national medical insurance (*e.g.*, NHS in the U.K.) or robust private medical insurance system. The per capita national healthcare expenditure of China neighboring countries/areas (*e.g.*, Japan) are much higher than that of China.

Per Capita Healthcare Expenditure, 2019

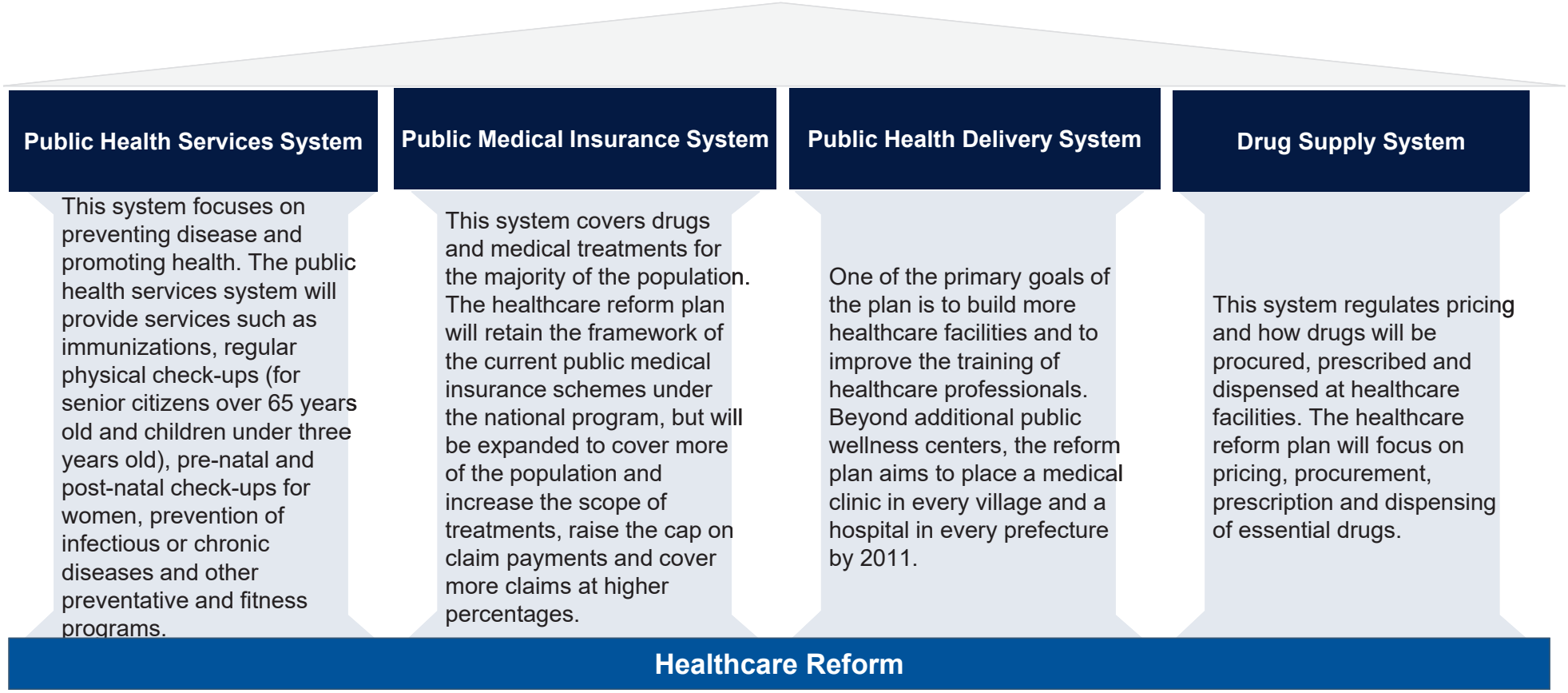


Note: USD-CNY Yearly Average Exchange Rates: 6.283627 (2015), 6.643058 (2016), 6.756806 (2017), 6.619897 (2018), 6.909792 (2019)

Source: WHO, NBSC, OECD, Frost & Sullivan Analysis

Overview of Healthcare Reform in China-I

- In early 2009, the Central Committee of China Communist Party along with the China State Council announced a comprehensive healthcare reform initiative through a program titled “Opinions on Deepening Pharmaceutical and Healthcare System Reform” (关于深化医药卫生体制改革的意见). The plan primarily targets four fundamental healthcare systems in China.



Sources: Government Notice, Frost & Sullivan Analysis

Overview of Healthcare Reform in China - II

The ultimate goal of healthcare reform: everyone can have access to and afford basic healthcare services

The 13th Five-year Plan

In December 2016, the 13th five-year plan for medical development was released, proposing a new round of healthcare reform plan:

- Further improve the medical system, including primary-level medical and health services, hierarchical diagnosis and treatment, medical quality and safety management, and vigorously develop nongovernmental hospitals.
- Establish a primary universal medical insurance system, accelerate the development of commercial health insurance, promote payment system reform, and improve the drug supply security system.
- Reform the pharmaceutical system, encourage the innovation of drugs and medical devices, accelerate the evaluation of the consistency of the quality and efficacy of generic drugs, implement the 'two-invoice' reform of drug procurement, and improve the drug price negotiation mechanism.
- Strengthen maternal and child health care and birth services, develop elderly health services, promote the health of targeted populations such as the poor, and improve family planning policies.

Medium- and Long-term Goals by 2021

The year 2020 is the end of the 13th Five-Year Plan, and the 14th five-year plan will soon begin in 2021:

During the 13th Five-Year Plan period (2016-2020), China has shifted from a focus on medical treatment to a focus on health. Remarkable progress has been made in the reform and development of health services. The health level of urban and rural residents has continued to improve, and the building of a healthy China has got off to a good start.

Key tasks of 《Deepen the reform of the medical and health care system in 2021》:

- Further promote the experience of medical reform in Sanming City, accelerate the coordinated reform of medical treatment, medical insurance and medicine。
- Promote a balanced distribution of quality medical resources and improve the tiered diagnosis and treatment system
- Adhere to prevention first and strengthen the construction of a public health prevention system
- Coordinate and promote relevant key reforms to form a joint force

Healthy China 2030 Planning Outline

The State Council issued the outline of *Healthy China 2030 Planning* on Oct 2016:

By 2030, the system for promoting universal health will be better, the development of the health field will be more coordinated, the healthy lifestyle will be popularized, the quality of health services and the level of health protection will continue to improve, the health industry will prosper and develop, the health equity will be basically achieved, and the main health indicators entered the ranks of high-income countries.

The outline establishes the main indicators of healthy China 2030 planning:

- People's health continues to improve.
- Main health risk factors are effectively controlled.
- Health service capacity will be greatly improved.
- Significant expansion of the health industry.
- Improve the health system.

Source: Government Notice, Frost & Sullivan Analysis

Overview of Healthcare Reform in China-III

《Healthy China 2035 Planning Outline for 14th Five-year Plan》

The goal of Healthy China 2035 Planning Outline: give top priority to the protection of people's health in the strategic position of development, adhere to the principle of putting prevention first, deepen the implementation of the Healthy China Initiative, improve the national health promotion policy, strengthen the national public health protection net, and provide full range of life-cycle health services for people.

In the next five years, the state will jointly promote the development of public health, medical services, universal medical insurance and other health systems, and accelerate the expansion of quality medical resources and balanced distribution among regions.

In March 2021, the 14th five-year plan for medical development was released, chapter 44 points out the comprehensive promotion of the construction of healthy China 2035

- Section 1: Building a Strong Public Health System
- Section 2 Deepening the reform of the medical and health care system
- Section 3 Improving the National Medical Insurance System
- Section 4: Promoting Inheritance and Innovation of Traditional Chinese Medicine
- Section 5 Building a Nation in Sports
- Section 6 Conducting in-depth patriotic health campaigns

The National Health Security Project

The Healthy China 2035 Planning also released a national health security project.

- **Disease prevention and control**

Launch the second phase of the project of the Chinese Center for Disease Control and Prevention, build about 15 regional public health centers based on existing disease control and prevention institutions, upgrade and renovate about 20 national bases for prevention, control and treatment of major infectious diseases and 20 national bases for emergency medical assistance

- **National Medical Center**

Strengthen the development of national medical centers for cardiovascular, respiratory, oncology, trauma and pediatrics. Focusing on major diseases to build several leading domestic and globally influential high-level medical centers and medical innovation transformation.

- **Regional Medical Centre**

Support high-level medical institutions to build a number of regional medical centers in provinces with a lot of medical treatment and weak medical resources, and build regional medical centers in Hebei, Henan, Shanxi, Liaoning, Anhui, Fujian, Yunnan, Xinjiang, etc. Center.

- **County-level Hospital**

Promote provincial and municipal high-quality medical resources to support the development of county-level hospitals, and strive to increase the number of 500 county-level hospitals (including traditional Chinese medicine hospitals) to reach the level of tertiary hospital facilities and service capacity

- **Development of Traditional Chinese Medicine**

Set up about 20 national centers for the inheritance and innovation of traditional Chinese medicine,20 flagship hospitals in collaboration with Western medicine,20 bases for TCM disease prevention and treatment, and 100 key hospitals with TCM characteristics, forming a number of specialties with advantage.

- **National Fitness Facilities**

A total of 1,000 sports parks will be built, renovated or expanded, and supporting public infrastructure for household sports, fitness and leisure will be built. We will promote the construction of social football venues and fitness trails

Source: Government Notice, Frost & Sullivan Analysis

Policy Analysis of Healthcare Services in China (1/3)

Policy	Release Date	Issuing Authority	Comments
《Notification about Further Improving Healthcare Services and Security for Severely Disabled Persons》	2016-04	NHCRC, MCARC, MFRC, etc	Fully understand the significance of healthcare service and security work for severely disabled persons; Continuous improvement of healthcare services for severely disabled persons; Practical implementation of various policies and measures for the Healthcare security of severely disabled persons.
《Healthy China 2030 Plan》	2016-10	State Council	Promote equal access to basic public health services, especially in rural areas and at the primary level, and maintain the public welfare of basic healthcare services; Focus on the primary level and integrate health into all the policies. Strengthen the development of primary-level personnel, with the focus on general practitioners, and reinforce the support at the primary level and in remote areas.
《Plan for Deepening the Reform of the Medical and Healthcare Systems During the 13th Five-Year Plan》	2017-01	State Council	Shift downward the focus of healthcare work and medical resources, and improve the occupational attractiveness and service capacity of primary-level healthcare. The major goal of deepening the reform of the medical and healthcare system by 2020: medical liability insurance will cover all public hospitals and more than 80 percent of primary-level medical institutions.
《Evaluation indicators of the Action Plan for Further Improving Healthcare Services (2018-2020)》	2018-10	NHCRC	In order to guide the improvement of healthcare service effect assessment work, strengthen the guidance and assessment of the improvement of healthcare service work, and ensure the orderly progress of all work.
《Implementation Plan for Setting Up National Healthcare Center and National Regional Healthcare Center》	2019-01	NHCRC	In order to strengthen the supply-side reform of the healthcare service system, further improve the allocation of regional high-quality healthcare resources, promote the homogenization of healthcare services, and help build a hierarchical diagnosis and treatment system in line with China's national conditions.

Source: Government Notice, Frost & Sullivan Analysis

Policy Analysis of Healthcare Services in China (2/3)

Policy	Release Date	Issuing Authority	Comments
《Key Work Plan for Deepening the Implementation of the Action Plan for Further Improving Healthcare Services in 2019》	2019-03	NHCRC, NATCM	Strengthen the construction and consolidation of key systems such as scientific establishment of appointment system; Strengthen the improvement and optimization of key services and continue to thoroughly implement the action plan for further improving healthcare services.
《Opinions on Promoting the Sustainable, Healthy and General Practice Development of Non-governmental Medical Institutions》	2019-06	NHCRC, NDRM, MFRC, etc	Actively guide nongovernmental forces to run medical institutions, and incorporate nongovernmental hospitals into the system of healthcare services and medical quality management, control and evaluation, so as to continuously improve the quality and safety of nongovernmental hospitals and medical services.
《Opinions on Deepening the Reform of the Medical Security System》	2020-03	State Council	Improve the fair and appropriate treatment guarantee mechanism; Improve the sound and sustainable financing operation mechanism; Coordinating the reform of the supply side of medical services; Optimizing the public management service of medical security; Establish an effective and efficient medical insurance payment mechanism.
《Key Tasks for Deepening the Reform of The Medical and Health Care System in the Second Half of 2020》	2020-07	State Council	Strengthen the public health system; Deepen the implementation of the Healthy China campaign; Deepen the comprehensive reform of public hospitals. Deepen reform of the medical security system. Improve the drug supply system.
《The CPC Central Committee and the State Council on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization》	2021-02	State Council	Comprehensively improve community-level health services; Build a number of central health centers; Strengthen the construction of county-level hospitals and integrated medical organizations at the county level, and improve basic healthcare and strengthen the health services for the focus groups

Source: Government Notice, Frost & Sullivan Analysis

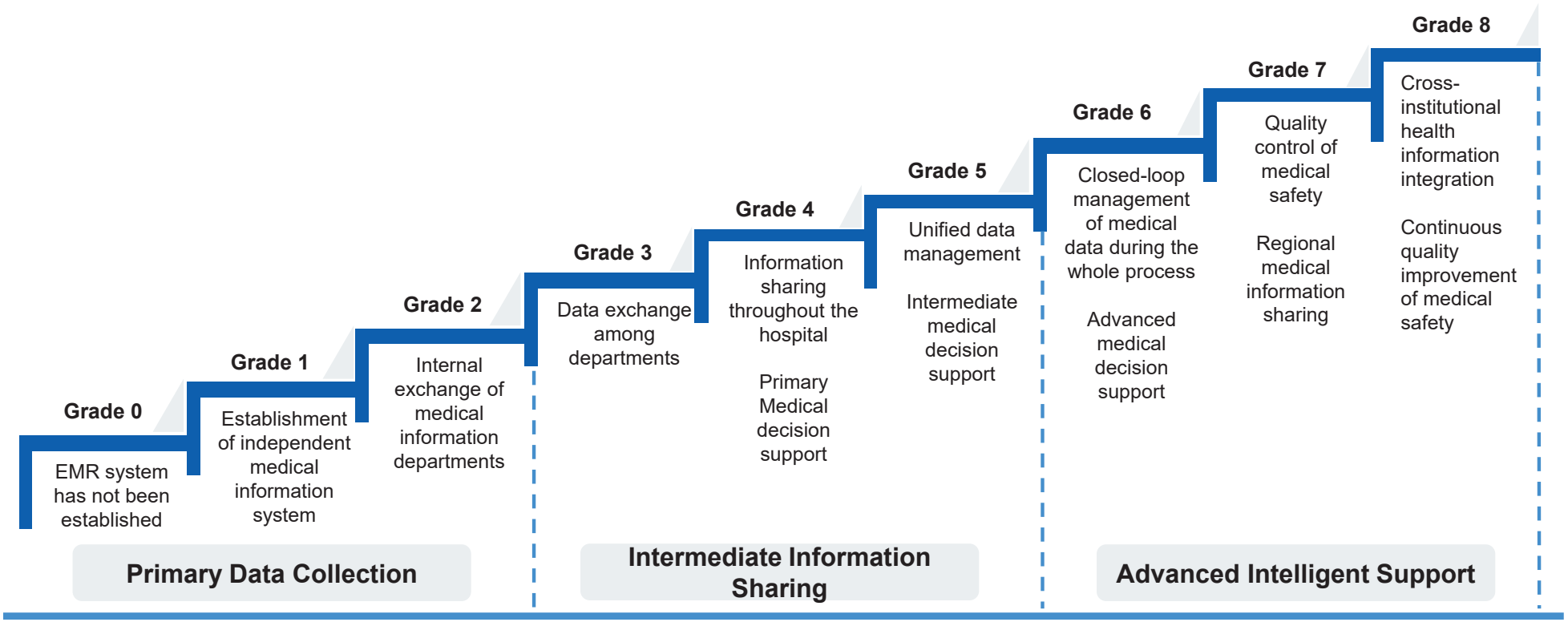
Policy Analysis of Healthcare Services in China (3/3)

Policy	Release Date	Issuing Authority	Comments
《The 14th Five-Year National Health Plan》	2022-04	State Council	• Promoting "Internet + Chronic Disease Management", realizing online follow-up of chronic diseases, prescription flow, medical insurance settlement and drug delivery.
《The 14th Five-Year Plan for National Health Informationization》	2022-11	NHCRC	• Promoting the development of "Internet + Healthcare" services and the application of healthcare big data. • Making efforts to achieve breakthroughs in information interoperability and sharing, and intelligent services for key populations.
《Opinions on Further Improving the Medical and Health Care Service System》	2023-03	State Council	• Developing "Internet + Healthcare", building an industrial Internet platform for the medical field, accelerating the application of the Internet, artificial intelligence, cloud computing and big data in healthcare, and strengthening the construction of a system for sharing, exchanging and safeguarding big data in healthcare. • Increasing support for the training of grass-roots professionals, and narrow the gap in the allocation of manpower between urban and rural areas and between regions.
《Improve medical Experience and Enhance Patient Experience Theme Activity Program (2023-2025)》	2023-05	NHCRC, State Administration of Traditional Chinese Medicine	• Relying on the medical union to improve the continuity of medical services, using the grid layout of urban medical groups and county medical communities as carriers, optimize the medical service process, smooth two-way referral channels, sink medical resources, and provide integrated medical and health services for residents in the grid. • Promoting the sharing of diagnosis and treatment information within the medical consortium, and explore the establishment of a smart medical consortium. • Building smart hospitals; Actively explore the use of artificial intelligence technology to improve patient medical experience and provide high-quality assistance for clinical diagnosis and treatment services.

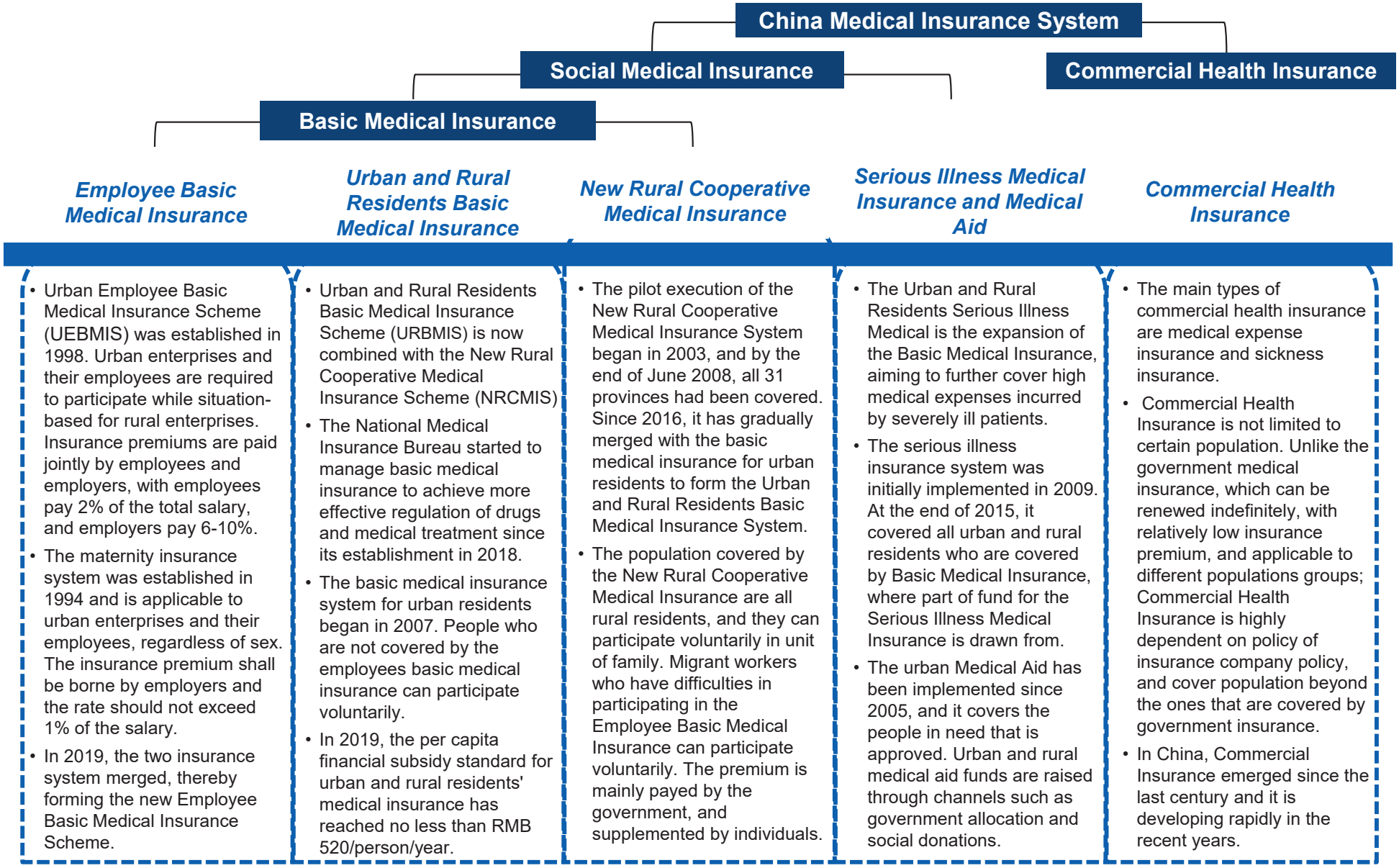
Source: Government Notice, Frost & Sullivan Analysis

Electronic Medical Record System Grading Standards in China

- In 2018, the government proposed *the Administrative Measures for Grading Evaluation of Application Level of Electronic Medical Record System (Trial)《电子病历系统应用水平分级评价管理办法（试行）》*. It stipulates the standards for different grades of EMR system, and proposes that by 2020, all Class III hospitals should reach Grade 4 or above, and Class II hospitals should reach Grade 3 or above. The followings are the details:
- Grade 0-2 requires the realization of internal data exchange within the hospital; Grade 3-5 requires to achieve data management of the whole hospital and provide medical decision support; Grade 6-8 requires regional medical information sharing and cross-agency information integration.
- Thus, realizing the regional medical information sharing is the direction and the goal of the construction of EMR system and smart hospital.



Overview of Medical Insurance System in China



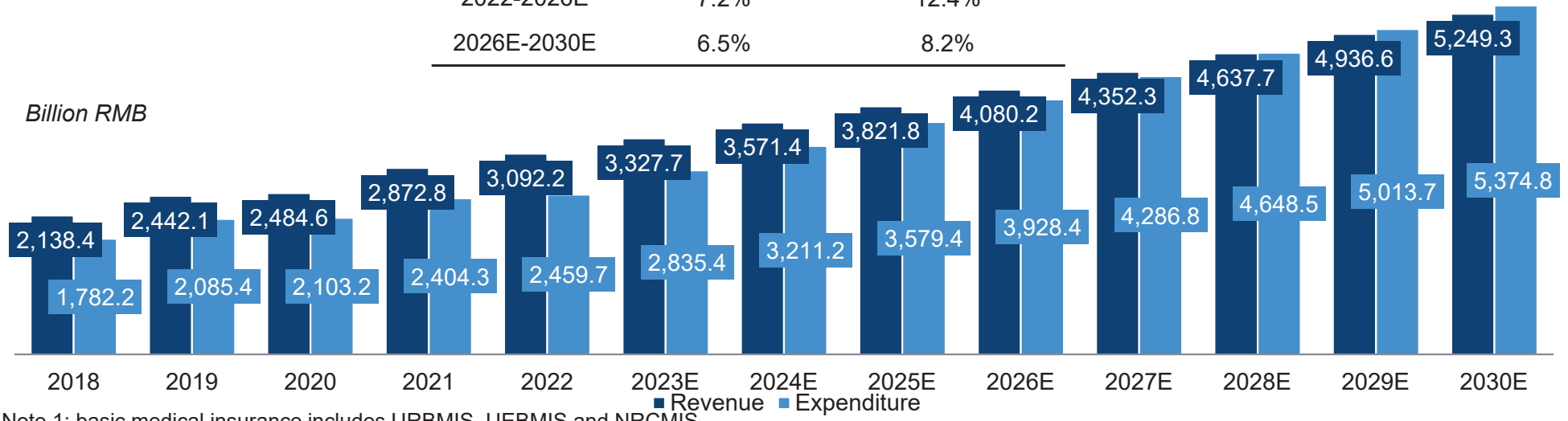
Source: Frost & Sullivan Analysis

Basic Medical Insurance Fund in China, 2018-2030E

- The revenue of basic medical insurance fund has increased from RMB 2,138.4 billion in 2018 to RMB 3,092.2 billion in 2022, with a CAGR of 9.7%, while the expenditure has increased from RMB 1,782.2 billion in 2018 to RMB 2,459.7 billion in 2022, representing a CAGR of 8.4% during the indicated period.
- The revenue is expected to continue its growth while the expenditure will experience a much higher growth if no intervention is implemented. The revenue and the expenditure is projected to reach RMB 4,080.2 billion and RMB 3,928.4 billion in 2026, respectively. The expenditure will reach RMB 5,374.8 billion in 2030. Therefore, there is a high willingness to control the expenditure of basic medical insurance fund, which can be achieved through digital technologies.
- The number of participants in the basic health insurance program reached 1,362.97 million, with a coverage rate of 96.5% of the total population in China.

Revenue and Expenditure of Basic Medical Insurance Fund[1], 2018-2030E

Period	CAGR	
	Revenue	Expenditure
2018-2022	9.7%	8.4%
2022-2026E	7.2%	12.4%
2026E-2030E	6.5%	8.2%



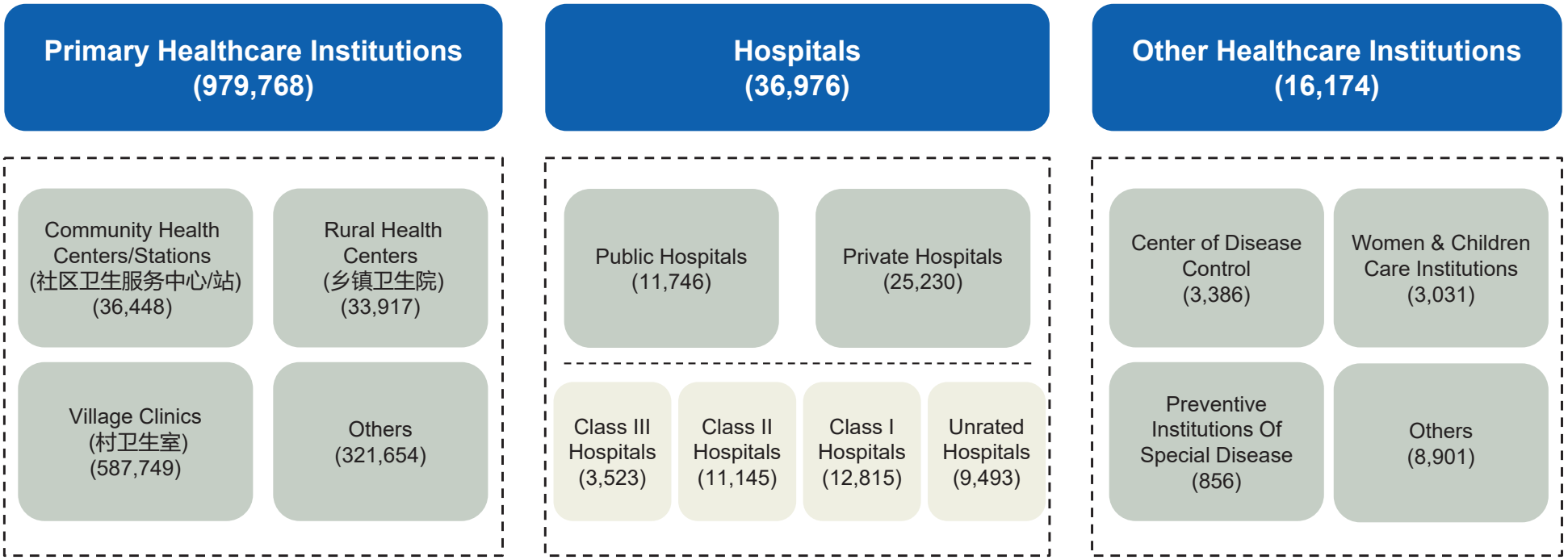
Note 1: basic medical insurance includes URBMIS, UEBMIS and NRCMIS.

Source: NMPA, Frost & Sullivan Analysis

Overview of Healthcare Service System in China, 2022

- At present, China's healthcare providers consist of hospitals, primary healthcare institutions, and other healthcare institutions, among which hospitals play the most important role.
- There were 36,976 hospitals in China by the end of 2022, including 1,716 Grade A tertiary hospitals. With regards to the ownership, China's hospitals are mainly categorized as public hospitals and private hospitals. With regards to the specialization, China's hospitals consist of general hospitals, specialized hospitals, traditional Chinese medicine(TCM) hospitals, and other hospitals. With regards to the tier of hospitals, China's hospitals are categorized as Class I hospitals, Class II hospitals and Class III hospitals. Each tier has three levels – A, B and C, for example, Grade A Primary hospital, Grade B Primary hospital. Class and levels are evaluated according to the hospital's size, technique level, medical equipment, management level, service quality and etc.

Chinese Healthcare Service System, 2022



Source: NHFPC, Frost & Sullivan Analysis

Comparison of Medical Services Quality between the United States and China

	the U.S.	China
Medical Team Structure	• One doctor, one nurse, one assistant and one secretary are required to serve 1,430 people.	• One doctor and one nurse is the mainstream configuration, with 4,632 people to serve.
Speed and Efficiency of Bed Turnover	• The U.S. has increased its focus on clinical pathways to reduce the number of worthless hospital days for patients and improve bed turnover. The average hospitalization day was 4.7 days.	• The average hospital stay in China is 11 days.
Outpatient Appointment System	• The U.S. uses an outpatient appointment system, in which patients make appointments directly with their doctors, and tests and preparations are completed prior to the visit.	• China uses a registered appointment system, queuing up to communicate with the doctor, after which the doctor arranges for the appropriate tests to be done. And only then can you proceed to complete the visit and the appropriate treatment.
Patterns of Work in Hospitals	• The U.S. hospitals routinely adopt a multidisciplinary and multidisciplinary collaborative treatment (MDT) working model, which provides joint treatment from multiple perspectives, such as specialties, psychology, and rehabilitation, improving the scientific nature of diagnostic and treatment protocols.	• The lack of effective coordination and communication between hospital departments in China makes it difficult to achieve optimal treatment outcomes.
Informatization Resources	• The U.S. health informatization started early and has accumulated a lot of successful experiences, and in 2004, the National Coordinating Office for Health Information Technology was established to take charge of the national health informatization work. However, due to the U.S. political system and competition in the health care market, all electronic cases and other health care information are mostly stored in third-party organizations.	• In China, the slow progress of the country's construction of healthcare information, the low participation of doctors at all levels of hospitals, and the low level of informatization have led to the weak construction of healthcare informatization, and there is a large gap between its application and management and that of the United States. The difference is that the healthcare informatization platform established in China is fully funded and managed by the government, which facilitates the implementation of timely and effective medical measures by hospitals, as well as citizens' understanding and support of hospitals' medical assistance practices.

Source: Literature Review, Frost & Sullivan Analysis

Growth Drivers of China Healthcare Service Market

Aging Population Trend in China	• With the increasing life expectancy, China has entered an aging society. From 2018 to 2022, population is aging rapidly in China with people aged above 65 grew at a CAGR of 5.9% over the period. According to the NBSC, individuals aged above 65 years old reached 209.8 million in 2022. The number of individuals aged above 65 years old is growing at a fairly fast pace and is expected to continue its growth momentum into the future and the population is expected to grow to 273.2 million by 2030. China's demographic shift offers immense opportunities for healthcare service providers, as elder people generally have a greater need for healthcare services and are more likely to seek healthcare service to fight diseases.
Rising Income Level of Chinese residents	• Along with the continuous growth in economy and urbanization, the average income level of the Chinese residents has also increased continuously in recent years. The growth of Chinese per capita disposable income has demonstrated positive effect on Chinese residents' purchasing power. Given the increasing health awareness among Chinese population, the rising purchasing power will continue to drive the healthcare service market to grow in the near future.
Increasing Prevalence of Chronic Disease	• Complex reasons such as unhealthy life-style, high social and living pressure and environmental pollution have led to upward tendency of chronic disease prevalence. For example, the prevalence of hypertension and diabetes have both increased by more than 4 times from 2003 to 2013.Furthermore, chronic diseases have led to more than 80% of deaths in China according to WHO, indicating the management of chronic diseases is one major concern of Chinese residents in modern society. The rising chronic disease prevalence is expected to spur the healthcare spending, particularly to meet the long-term demand for chronic disease treatment.
Advancements in Diagnostics and Academic Research	• Advances in diagnostic technologies and academic research contribute to better healthcare quality by enabling earlier and more accurate disease detection and treatment, which can lead to more effective and less costly treatments. • With the in-depth application of emerging technologies in the medical field, artificial intelligence has, to a certain extent, expanded the geographic coverage of high-quality medical services and the population, improved the overall level of medical services, and promoted the digital transformation of the medical industry through the empowerment of the supply side of medical services.

Source: Frost & Sullivan Analysis

Future Trends of China Healthcare Service Market

Creative Way of Healthcare Service Delivery	• The trending creative way of healthcare service delivery is to integrate online and offline healthcare services. This online + offline healthcare service mode effectively addresses the unequal healthcare service accessibility issue resulted from the highly uneven distribution of medical resources. Besides, online + offline medical platforms enable provision of high-quality services being due to improved efficiency of the overall healthcare service process. The overall healthcare service process include components in steps such as the supply chain, diagnosis, treatment and management of diseases.
Digital Technology Empowering Personalized Treatment	• Given an increasing attention to precision medicine, patients can potentially get better treated with treatment tailored to their own condition. With help of digital technology, detailed health profiles are stored online, analyzed thoroughly and kept updated, matching the patient with the best possible therapeutic option available. It is expected that in the future, with more types of data being collected electronically, more information can be utilized and personalized treatment will be applied wider in digital healthcare service market.
Decentralization of Healthcare Services	• Decentralization is seen as a way to create a more equitable and patients-oriented healthcare system in China. The Chinese government has encouraged the establishment and growth of private hospitals to increase healthcare capacity and reduce the burden on public hospitals. Meanwhile, China has been establishing and expanding Community Health Centers (CHC) in urban and rural areas, which play the critical role in providing primary healthcare services, health education, chronic diseases management and preventive care to residents.
Transformation of the Purpose of Healthcare Services to the Patients-Oriented Mode	• Since the 13th Five-Year Plan, China has continued to promote the healthcare reform by transforming treatment-oriented services to patient-oriented ones, and has made great efforts to address the issue of little access and affordability. • In the Action Plan for Comprehensively Improving the Quality of Healthcare (2023-2025), it is required to place the protection of people's wellness in the strategic position of prioritizing development, with the theme of promoting the high-quality development of healthcare services, and with the main direction of improving the quality of supply.

Source: Frost & Sullivan Analysis

Table of Content

Overview of Artificial Intelligence

- There is no single universally agreed upon definition of Artificial Intelligence (AI). In practice. The term artificial intelligence broadly refers to applications of technology to perform tasks that resemble human cognitive function and is generally defined as “the capability of a machine to imitate intelligent human behavior.” AI typically involves the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
- In practice, AI encompasses a broad spectrum of different technologies, some of which are described below.

Key Technologies

Key general purpose technology standards mainly focuses on machine learning, knowledge graphs, brain-inspired intelligent computing, quantum intelligent computing, and pattern recognition to provide general purpose technological support for AI applications.

Machine learning	Knowledge graphs	Brain-inspired intelligent computing
Quantum intelligent computing	Pattern recognition	

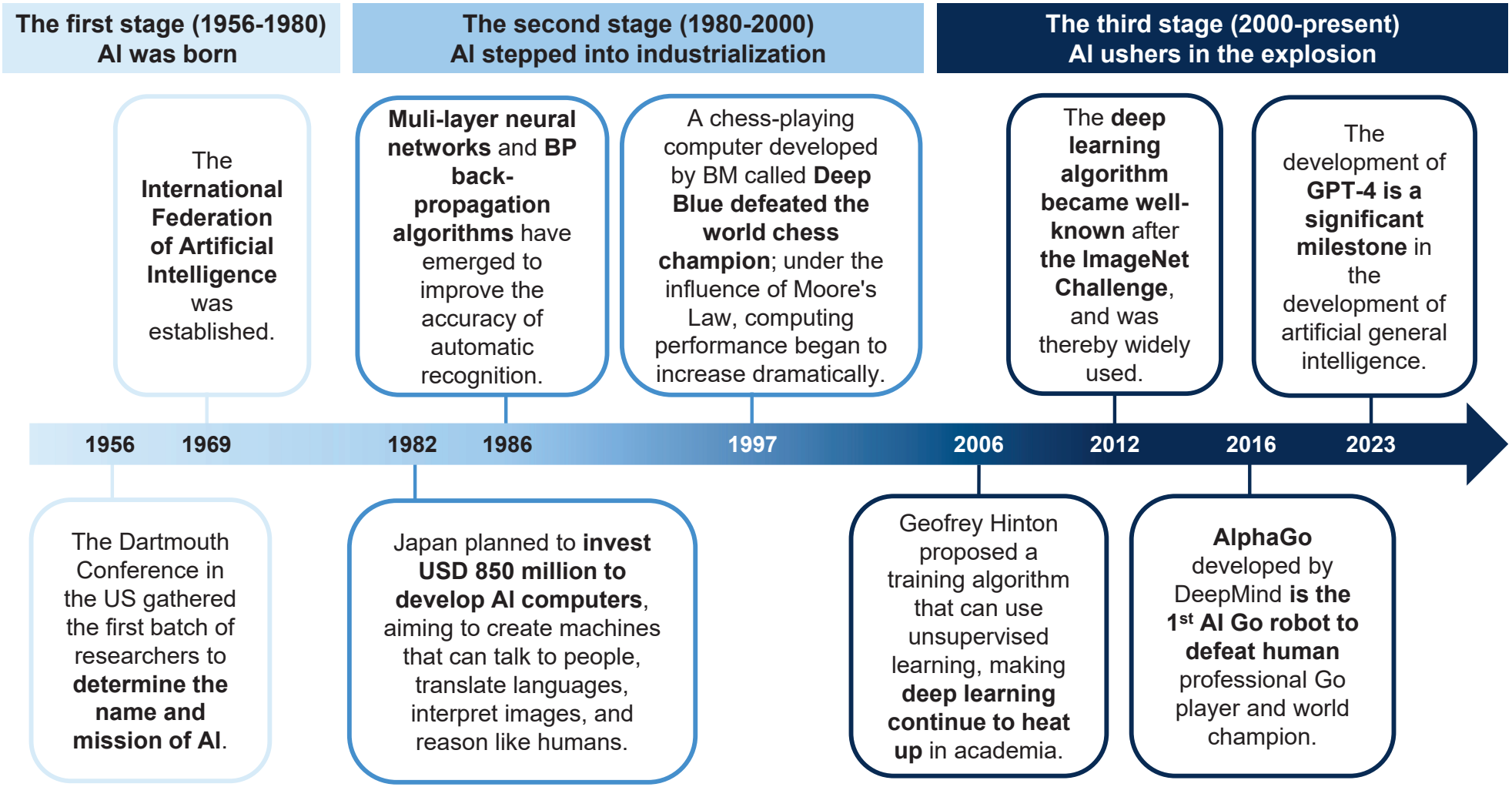
Key niche technology standards mainly focuses on natural language processing, intelligent speech, computer vision, biometric feature recognition, virtual reality and augmented reality (VR/AR), and human-computer interaction to provide niche technology support for AI applications.

Natural language processing	Intelligent speech	Computer vision
Biometric feature recognition	VR/AR	Human-computer interaction

Source：Frost & Sullivan Analysis

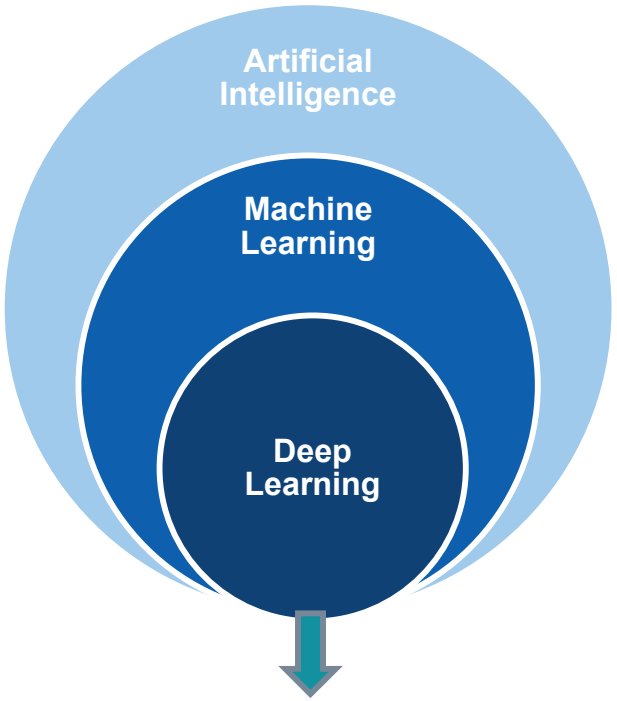
The Development of Artificial Intelligence

- The history of AI can be roughly divided into three stages: the first stage (1956-1980) AI was born; the second stage (1980-2000) AI stepped into industrialization; the third stage (2000-present) AI ushers in the explosion.



Source：Frost & Sullivan Analysis

Relationship between AI, DL and CNN



Deep Learning has three fundamental network structure: Convolutional Neural Networks (CNN), Recurrent Neural Networks and Recursive Neural Networks.

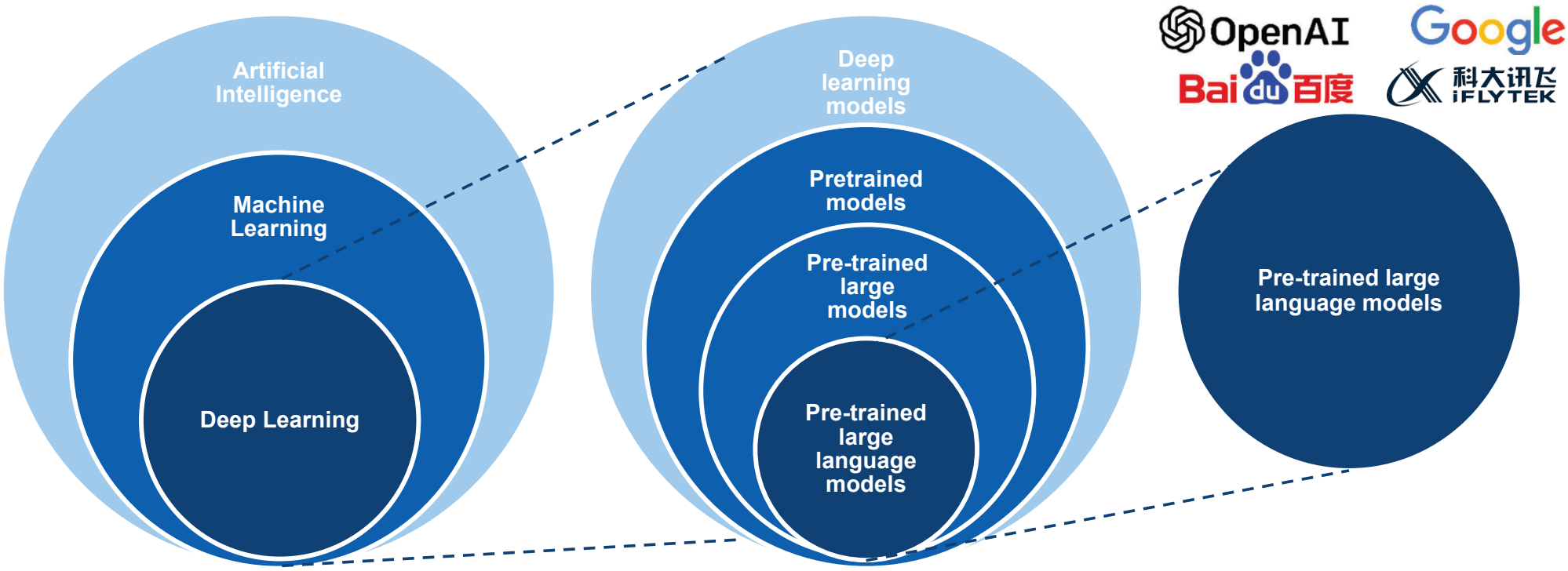
Relationship between AI, DL and CNN

- AI and DL is bridged through machine learning (ML). ML is a subset of AI, and it consists of the techniques that enable computers to figure things out from the data and deliver AI applications. DL is a subset of ML that enables computers to solve more complex problems
- AI is the most general of these terms, as it includes systems that aim to mimic human intelligence by learning from data and by applying manually defined decision rules.
- Machine learning includes neural networks but also pertains to other methods, such as kernel methods and decision tree–based methods.
- Among neural networks, deep learning, which involves study of neural networks consisting of many layers, is currently the most successful in practical applications and the subject of the most intense research. It is foreseeable that deep learning will lead to a major change in the automated analysis of images.
- The type of deep neural networks which is frequently applied in medical image analysis are the convolutional neural networks.
- The success of CNN has triggered new interest in the development of better automated image analysis methods. In the past few years, similar deep neural networks were shown to be highly effective ranging from face recognition to self-driving cars. Recent studies have shown that CNNs can also be highly successful in various tasks in the health care industry, ranging from retina analysis to digital pathology , and in multiple applications in radiology.
- Conclusion: Deep learning is a collection of multi-layer neural networks using various learning algorithms to solve image, text and other related problems. As an important algorithm of deep learning, convolutional neural network is especially good at image processing. Convolution neural network uses convolution kernel to extract various features of the image, and greatly reduces the order of magnitude of network training through weight sharing and pooling.

Source：Frost & Sullivan Analysis

Relationship between DL and Pre-trained LLMs

- Large Language Models (LLMs) are a subset of deep learning. Large language models are first pre-trained so that they learn basic language tasks and functions.



Source：Frost & Sullivan Analysis

Overview of Large Language Models

- Large language models (LLMs) are deep learning algorithms that can recognize, summarize, translate, predict, and generate content using very large datasets.
- Large language model is a type of artificial intelligence model that is trained on a massive dataset of text. This dataset can be anything from books and articles to websites and social media posts. The LLM learns the statistical relationships between words, phrases, and sentences in the dataset, which allows it to generate text that is similar to the text it was trained on. There are multiple steps to the working of a large language model.

Steps		Data Collection
1	**Data collection**	Books, articles, websites, and other sources of written text
2	**Tokenization**	Tokenization involves breaking down the text into smaller units called tokens. Tokens can be words, subwords, or characters, depending on the specific model and language. Tokenization allows the model to process and understand text at a granular level.
3	**Pre-training**	The model learns to predict the next token in a sequence, given the preceding tokens. This unsupervised learning process helps the LLM understand language patterns, grammar, and semantics.
4	**Transformer architecture**	The mechanism computes attention scores for each word in a sentence, considering its interactions with every other word. Thus, by assigning different weights to different words, LLMs can effectively focus on the most relevant information, facilitating accurate and contextually appropriate text generation.
5	**Fine-tuning**	Fine-tuning involves providing the model with task-specific labeled data, allowing it to learn the intricacies of a particular task. This process helps the LLM specialize in tasks such as sentiment analysis, Q&A, and so on.
6	**Inference**	Inference involves utilizing the model to generate text or perform specific language-related tasks.
7	**Contextual understanding**	They use the information provided in the input sequence to generate text that considers the preceding context.
8	**Beam search**	Beam search is a search algorithm that explores several possible paths in the sequence generation process, keeping track of the most likely candidates based on a scoring mechanism. This approach helps generate more coherent and high-quality text outputs.
9	**Response generation**	LLMs generate responses by predicting the next token in the sequence based on the input context and the model's learned knowledge.

Source：Frost & Sullivan Analysis

Applications and Major Players of Large Language Models

- LLMs have been leveraged for a wide range of applications. They can be fine-tuned on specific tasks by providing additional supervised training data, allowing them to specialize in tasks such as sentiment analysis, or even playing games like chess. They can also be deployed as chatbots, virtual assistants, content generators, and language translation systems.

Examples of Global Major Players

Players	Example of Models	Training dataset
OpenAI	GPT-4	> 1 trillion
Microsoft Meta	Llama 2	> 2 trillion
Google	PaLM 2	>300 billion
BigScience	Bloom	> 100 billion
AI21 labs	Jurassic-2	> 100 billion
ANTHROPIC	Claude 2	> 100 billion
Yandex	YaLM 100B	> 100 billion
	GPT-NeoX-20B	>20 billion
Microsoft	Copilot (Bing Chat)	N/A

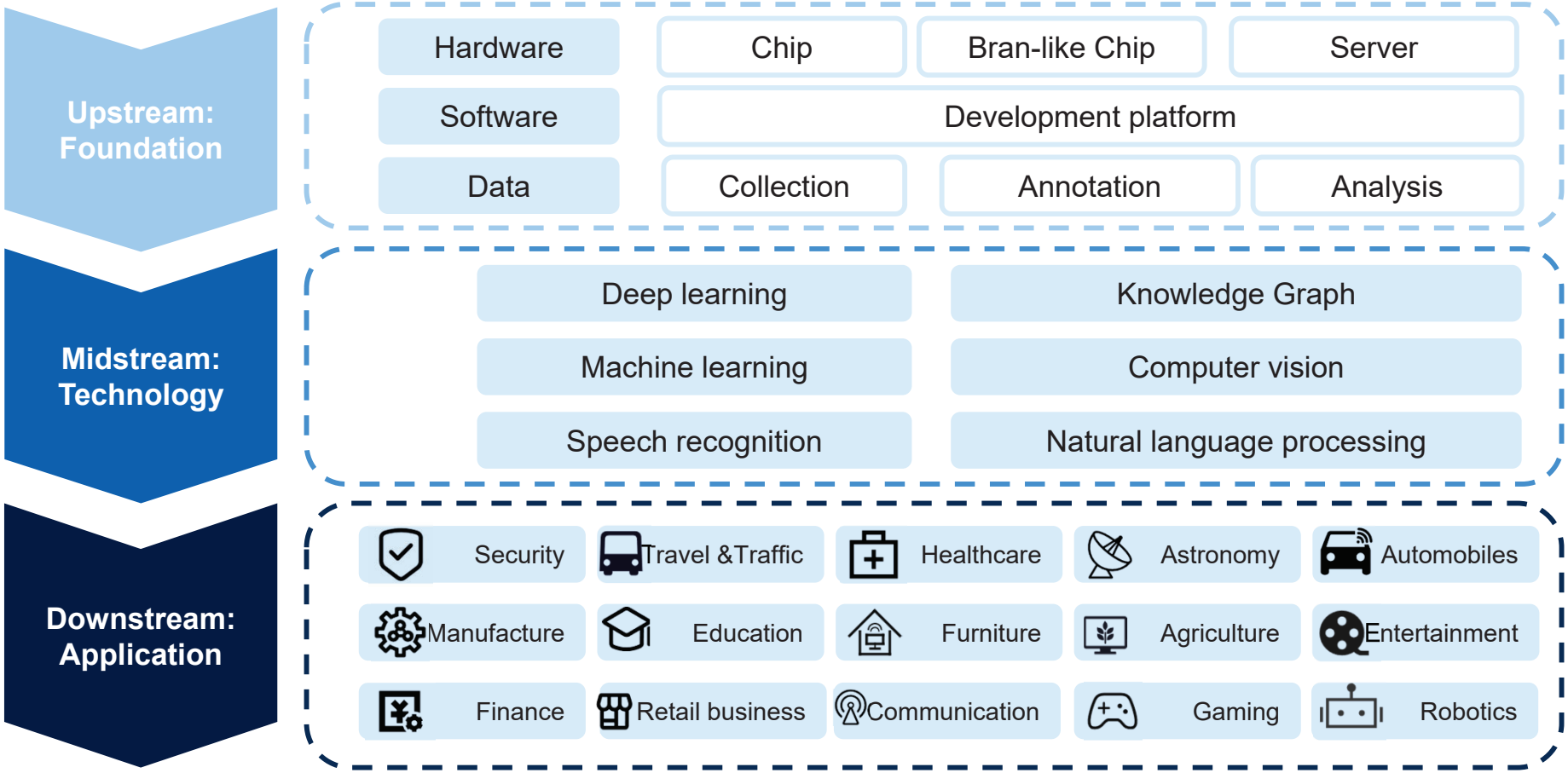
Examples of China Major Players

Players	Example of Models	Training dataset
Baidu 百度	Wenxinyiyan	> 1 trillion
inspur 浪潮	Yuan	> 200 billion
科大讯飞 iFLYTEK	SparkDesk	> 100 billion
商汤 sensetime	SenseChat	> 100 billion
HUAWEI	PanguLM	> 100 billion
	360Zhinao	> 100 billion
阿里巴巴	Tongyi Qianwen	>100 billion
智谱·AI	ChatGLM3	>100 billion
Tencent 腾讯	Hunyuan	>100 billion
云知声 Unisound	Shanhai	>100 billion
思必驰 AISPEECH	DFM-2	>10 billion

Source：Frost & Sullivan Analysis

Value Chain of Artificial Intelligence

- The artificial intelligence industry chain can primarily be divided into three levels: the foundational layer, the technology layer, and the application layer. The foundational layer focuses on establishing basic support platforms, including elements such as chips, development platforms, and data services. The technology layer mainly encompasses general technologies like natural language processing, and algorithm models such as deep learning and machine learning. Artificial intelligence has a wide range of applications, including solution services for various industries, as well as hardware and software products. It is currently being applied in industries such as healthcare, manufacturing, and telecommunications.



Source：Frost & Sullivan Analysis

Examples of AI Applications in Different Industries

Industry	Applications	Influence
Public Service	• Traffic flow analysis • Improving healthcare services • Enhanced large-scale infrastructure monitoring • Cyber attack prevention • Task automation via chatbots	• AI and machine learning algorithms provide data-driven analyses that aid officials in controlling traffic flow, preventing accidents and congestion, monitoring logistics, and improving road safety. • Governments can use AI to monitor the epidemiological situation, including predicting the mutation and infectivity of the virus, to provide preventive measures for disease control • Enables authorities to enforce policies that result in better infrastructure monitoring to fight illegal act • Government agencies sit on top of critical public and defense data. AI in government workflows allows agencies to prevent or minimize cyber attacks. • AI can be used to automate support tasks, such as by providing quick and accurate answers to citizens' questions through chatbots. This reduces the need for manual labor.
Healthcare	• Clinical decision support • Care delivery • Chronic care management • Self-care/Prevention • Triage and diagnosis • Diagnostics	• Artificial intelligence (AI) is fuelling a new revolution in medicine and in the health care sector, primarily for image analysis and disease diagnose. • AI can increase productivity and the efficiency of care delivery and allow healthcare systems to provide more and better care to more people. AI algorithms can catalyze the rapid analysis of health data, providing powerful tools to automate tasks and support , which can help improve the experience of healthcare practitioners, enabling them to spend more time in direct patient care and reducing burnout.
Automotive	• Manufacturing • Quality Control • Supply Chain • Passenger Experience • Driver Experience (autonomous driving)	• AI-based solutions will add more value to cars, resulting in further advancements in the development of autonomous driving, maximizing production capacity, accelerating production, and gathering data for improved road safety and passenger experience
Finance	• Credit card and loan decisions • Anti fraudery system • Risk management • Stock market predictions • Sales forecasting • Trading • Personalized banking • Process automation	• AI in finance can enhance how financial institutions analyze, manage, invest, and protect money. • AI provides a faster, more accurate assessment of a potential borrower, at less cost. Also, Fraud detection systems analyze clients' behavior, and buying habits and trigger a security mechanism when something contradicts the established spending pattern • Enormous processing power allows vast amounts of data to be handled in a short time, and cognitive computing helps to manage both structured and unstructured data, a task that would take far too much time for a human to do.

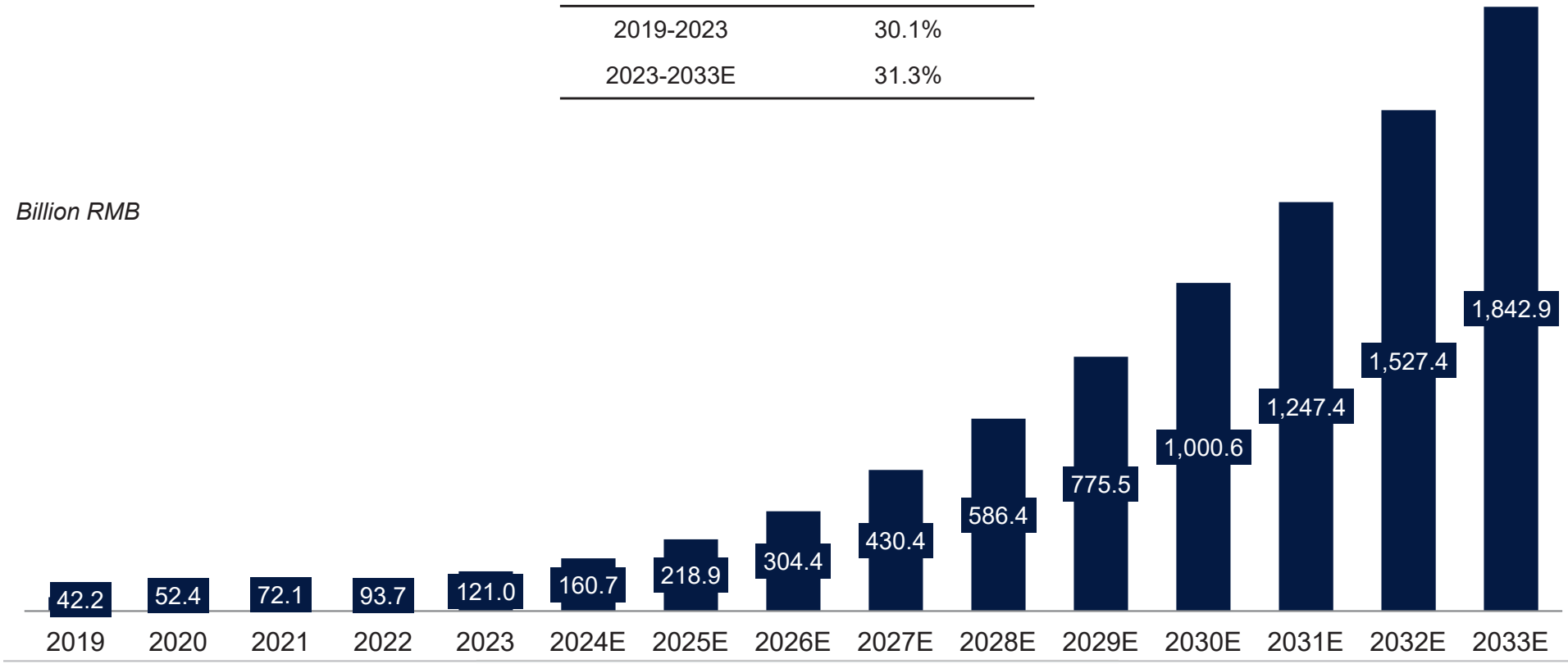
Source：Frost & Sullivan Analysis

Market Size of AI Solutions in China, 2019-2033E

- The market size of AI solutions in China increased from RMB42.2 billion in 2019 to RMB121.0 billion in 2023, representing a CAGR of 30.1%. The market size is expected to further grow to RMB 1,842.9 billion in 2033 with a CAGR of 31.3% from 2023 to 2033.

Market Size of AI Solutions in China, 2019-2033E

Period	CAGR
2019-2023	30.1%
2023-2033E	31.3%



Source: Public Companies' Filings, Company Official Websites, Frost & Sullivan Analysis

Policies of Artificial Intelligence (1/4)

Date	Government	Policies	Comments
2020/7/27	SAC, Office of the Central Cyberspace Affairs Commission, NDRC, MOST, MIIT	*"Guidelines for the Construction of a National New Generation Artificial Intelligence Standards System"* 《国家新一代人工智能标准体系建设指南》	• Promote the continuous self-optimization of AI technology in the open-source and open industrial ecosystem, to give full play to the leading role of basic general purpose standards, ethical standards, security standards, and privacy standards, to guide the formulation, revision, and coordination of AI national standards, industry standards, and group standards, and to form a new pattern in which standards lead the comprehensive and standardized development of the AI industry.
2020/10/29	MOST	*"The Guidelines for National New Generation Artificial Intelligence Innovation and Development Pilot Zone Construction Work (Revised Version)"* 《国家新一代人工智能创新发展试验区建设工作指引（修订版）》	• Develop innovative institutional mechanisms, deepen the cooperation of industry, academia, research institutions, and users, integrate superior resources, build a sound ecosystem conducive to the development of AI, comprehensively improve AI innovation and capabilities, create a number of new generation AI innovation development models, accumulate experience that can be replicated and scaled, and lead the healthy development of AI nationwide
2021/6/10	Standing Committee of the Thirteenth National People's Congress of the People's Republic of China	*"Data Security Law of the People's Republic of China"* 《数据安全法》	• Regulates data processing activities, safeguards data security, promotes data development and utilization, protects the lawful rights and interests of individuals and organizations, and maintains national sovereignty, security, and development interests
2021/7/4	MIIT	*"The Three-year Action Plan for New Data Centre Development (2021-2023)"* 《新型数据中心发展三年行动计划（2021-2023年）》	• Comprehensively promote the development of new-type data centers, build an intelligent computing power ecosystem centered around new-type data centers, and leverage their enabling and driving roles in the digital economy
2021/7/8	NMPA	*"The Classification Guidelines for Artificial Intelligence-AI Medical Devices and SaMDs (Software as Medical Devices)"* 《人工智能医用软件产品分类界定指导原则》	• Further strengthen the supervision and management of artificial intelligence medical software products to promote high-quality development of the industry

Source: Government Announcement, Frost & Sullivan Analysis

Policies of Artificial Intelligence (2/4)

Date	Government	Policies	Comments
2021/8/20	Standing Committee of the Thirteenth National People's Congress of the People's Republic of China	*"Personal Information Protection Law of the People's Republic of China"* 《个人信息保护法》	• Protects rights and interests relating to personal information, regulates personal information processing activities, and promotes the reasonable use of personal information
2021/9/26	The National New Generation Artificial Intelligence Governance Specialist Committee	*"Ethical Norms for New Generation Artificial Intelligence"*《新一代人工智能伦理规范》	• Aims to integrate ethics into the entire lifecycle of AI, to provide ethical guidelines for natural persons, legal persons, and other related organizations engaged in AI-related activities
2021/11/15	MIIT	*"The 14th Five-Year Plan for the Development of Software and Information Technology Services"* 《"十四五"软件和信息技术服务业发展规划》	• Deepen supply-side structural reforms as the main focus, thoroughly implement the national software development strategy, strengthen the leading role of major national software projects, enhance the capability of key software supply, accelerate the prosperity of the open-source ecosystem, consolidate the industrial development foundation, improve the modernization level of the industry and supply chains, comprehensively promote the industrialized and scaled application in key areas, continuously cultivate new momentum for digital development, and fully support the construction of a strong manufacturing nation, a powerful internet nation, and a digital China
2021/11/16	Cyberspace Administration of China, Ministry of Industry and Information Technology, Ministry of Public Security, State Administration for Market Regulation	*"Provisions on the Administration of Algorithm-generated Recommendations for Internet Information Services"* 《互联网信息服务算法推荐管理规定》	• Regulates algorithm-generated recommendations for Internet information services, promotes the core socialist values, safeguards the national security and public interest, protects the lawful rights and interests of citizens, legal persons, and other organizations, and boosts the sound and orderly development of Internet information services

Source: Government Announcement, Frost & Sullivan Analysis

Policies of Artificial Intelligence (3/4)

Date	Government	Policies	Comments
2022/1/12	The State Council of the People's Republic of China	*"The 14th Five-Year Plan for the Development of the Digital Economy"* 《“十四五”数字经济发展规划》	• Fully implement the new development philosophy, establish a new development paradigm, and promote high-quality development. Coordinate development and security, as well as domestic and international dimensions, with data as a key element. Focus on the deep integration of digital technology and the real economy as the main theme. Strengthen the construction of digital infrastructure, improve the governance system of the digital economy, and collaboratively advance the industrialization of digital technology and the digital transformation of industries. Empower the transformation and upgrading of traditional industries, cultivate new industries, new business models, and new patterns. Continuously enhance, optimize, and expand our country's digital economy, providing robust support for building a digital China.
2022/3/20	The Central Office of the Communist Party of China, The General Office of the State Council	*"Opinion on Strengthening the Ethics and Governance in Science and Technology“* 《关于加强科技伦理治理的意见》	• Further improve the systems on the ethics in Science and technology, enhancing the capacity of ethics and governance of Science and technology
2022/7/29	MOST,MIIT, Ministry of Transport, Ministry of Agriculture and Rural Affairs, National Health Commission	*“The Guiding Opinions on Accelerating Scenario Innovation and Promoting High-quality Economic Development with High level Application of Artificial Intelligence”* 《关于加快场景创新以人工智能高水平应用促进经济高质量发展的指导意见》	• Advance the innovation in artificial intelligence scenarios, focusing on solving major application and industrialization issues in artificial intelligence. Aim to comprehensively enhance the quality and level of development in artificial intelligence, thereby better supporting high-quality development
2022/8/12	MOST	*”Supporting the Construction of New-Generation Artificial Intelligence Demonstration Application Scenarios“* 《关于支持建设新一代人工智能示范应用场景的通知》	• Fully leverage the role of artificial intelligence in empowering the economic and social development, focusing on building a comprehensive, end-to-end ecosystem for the application of artificial intelligence in various industries

Source: Government Announcement, Frost & Sullivan Analysis

Policies of Artificial Intelligence (4/4)

Date	Government	Policies	Comments
2022/11/3	Cyberspace Administration of China, Ministry of Industry and Information Technology, Ministry of Public Security	*"Provisions on the Administration of Deep Synthesis of Internet-based Information Services"*(《互联网信息服务深度合成管理规定》)	• Strengthens the administration of deep synthesis of Internet-based information services, safeguards national security and public interests, and protects the legitimate rights and interests of citizens, legal persons, and other organizations
2022/12/9	The Supreme People's Court	*"The Opinions on Regulating and Strengthening the Applications of Artificial Intelligence in the Judicial Fields"*《关于规范和加强人工智能司法应用的意见》	• Promote the in-depth integration of artificial intelligence with judicial work, deepen the construction of smart courts, and strive to achieve a higher level of digital justice
2023/2/27	The Central Committee of the Communist Party of China, The State Council	*"Plan for the Overall Layout of Building a Digital China"*《数字中国建设整体布局规划》	• Comprehensively raise the comprehensiveness, systematicity, and coordination of Digital China construction; promote the deep integration of the digital economy and the real economy; drive the reform of productive life and governance methods
2023/3/27	MOST	*"Ministry of Science and Technology launches special deployment of 'AI for Science'"*科技部启动"人工智能驱动的科学研究"专项部署工作	• Closely integrate the key issues of basic disciplines including mathematics, physics, chemistry and astronomy and focus on the scientific research needs in key areas such as drug research and development, gene research, biological breeding, and new material research and development
2023/7/10	CAC, The National Development and Reform Commission, MOST, MIIT	*"Interim Measures for the Management of Generative Artificial Intelligence Services"*《生成式人工智能服务管理暂行办法》	• Promote the healthy development and regulated usage of generative AI, while safeguarding national security, societal public interests, and the legal rights of citizens and organizations

Source: Government Announcement, Frost & Sullivan Analysis

Challenges of China Artificial Intelligence Industry

Ethical Principles for Artificial Intelligence	• In the context of the development of artificial intelligence technology, considerations regarding its ethical regulation and societal impact have become increasingly prominent. For instance, in 2021, the Russian online payment service company Xsolla utilized algorithms to assess employees' low efficiency, resulting in the mass dismissal of a significant number of workers. Additionally, in 2019, Amazon's smart speaker provided advice encouraging self-harm. These examples highlight the importance of enhancing ethical monitoring and management of artificial intelligence to ensure the healthy development of the technology and the protection of societal order and human rights. In response to these challenges, the United Nations Educational, Scientific and Cultural Organization (UNESCO) calls upon nations to implement its "Recommendations on the Ethics of Artificial Intelligence." This global framework aims to provide comprehensive safeguards for AI technology to safeguard the collective well-being of humanity.
Data Privacy Risks	• In the process of artificial intelligence development, it is common practice to utilize user data for optimization and training. However, this practice may lead to the unauthorized disclosure of personal information, privacy, and trade secrets. The complexity and massive scale of AI models increase the risk of data leakage. Some European countries have already begun to restrict applications like ChatGPT in order to safeguard the security of personal information. For instance, on March 31, 2023, the Italian Data Protection Authority announced a ban on the use of ChatGPT, restricting the processing of Italian user data by ChatGPT's developer, OpenAI, and initiating a formal investigation.
More Stringent AI Regulations	• As the data-driven decision-making processes become increasingly prevalent in both the business and government sectors, regulatory frameworks governing data dimensions are becoming more stringent. This shift reflects growing public concerns regarding privacy protection, data security, and transparency. Globally, governments of various nations are enacting and enforcing more detailed and rigorous regulations to ensure the fair use of personal data and prevent its misuse. For instance, in June 2023, the European Parliament passed the "Artificial Intelligence Act (AI Act)," which represents a European Union regulation aimed at establishing a common regulatory and legal framework for artificial intelligence. These measures include enhancing transparency in data collection and processing, and imposing strict penalties for violations of data protection regulations. Therefore, businesses and organizations must adapt to this trend to ensure that their data management and processing procedures comply with increasingly stringent legal requirements.

Source: Frost & Sullivan Analysis

Opportunities of China Artificial Intelligence Industry (1/2)

The Digital Economy Drives Industrial Upgrading

- The digital economy, as a key driver in modern society, is leading a new wave of industrial upgrades. Integrating innovative technologies such as big data, cloud computing, and artificial intelligence, the digital economy not only accelerates the dissemination and efficiency of information processing but also provides personalized and efficient solutions for various industries including finance, manufacturing, education, healthcare, and retail. For instance, in healthcare, digital technologies like data analysis, AI, and telemedicine are increasingly integrated into medical services, improving the diagnosis and treatment of diseases. Harbin Institute of Technology has developed a large-scale Chinese medical model, "Bencao," which provides accurate and reliable diagnostic suggestions and treatment plans based on user queries, meeting the medical knowledge needs of non-professionals. In summary, digital tools such as electronic health records and intelligent diagnostic systems not only enhance the efficiency of medical services but also improve patient experiences. The digital economy boosts resource allocation efficiency, enabling sustainable development for enterprises, revitalizing traditional industries, and propelling the entire economy towards higher-level development.

Significant Commercial Value of AI Technology in Various Industries

- AI technology has demonstrated significant commercial value across various industries, particularly in enhancing efficiency, driving innovation, and optimizing service processes. For example, in the retail sector, the German startup Signatrix utilizes AI for in-store visual intelligence analysis, enhancing personalized customer experiences and precise inventory management. In finance, the American company Cleareye.ai's Topaz AML platform employs AI to improve the accuracy of anti-money laundering monitoring, thereby enhancing risk assessment and fraud detection efficiency. In healthcare, the American startup SAIVA applies AI to patient monitoring and triaging, increasing the accuracy of diagnoses and optimizing treatment plans. Additionally, in logistics, the Spanish startup Hedyla uses AI to optimize delivery routes, improving efficiency and reducing costs. In manufacturing, the Indian company Asquared's Equilips 4.0 device monitors manufacturing equipment with AI, enhancing production efficiency and process optimization. Thus, these applications of AI not only bolster innovation capabilities for businesses but also create new revenue streams and market opportunities, showcasing its irreplaceable value in the modern business landscape.

Source: Frost & Sullivan Analysis

Opportunities of China Artificial Intelligence Industry (2/2)

Policies Promote the Growth of Artificial Intelligence

- The Chinese government has shown significant macro-level support in the field of AI. On July 27, 2020, the Standardization Administration and other departments issued the "Guidelines for the Construction of a National New Generation Artificial Intelligence Standards System." This aimed to guide the revision and coordination of national, industry, and group standards in AI, leading to a new pattern of comprehensive standardization in the AI industry. On July 29, 2022, the Ministry of Science and Technology and other departments released "The Guiding Opinions on Accelerating Scenario Innovation and Promoting High-quality Economic Development with High level Application of Artificial Intelligence." This initiative seeks to advance AI scenario innovation and address significant application and industrialization issues in AI. Additionally, on July 10, 2023, the Cyberspace Administration of China, along with seven other departments, introduced the "Interim Measures for the Management of Generative Artificial Intelligence Services." Its purpose is to promote the healthy development of AI, ensuring national security and public interest. These policy directions not only provide a developmental roadmap for enterprises but also bring investment in capital and technology to the industry, further accelerating the research and application of AI.

The Industrial Clusters Promote the Artificial Intelligence Industry

- In the field of artificial intelligence, industrial regional clustering represents a significant opportunity for fostering innovation and synergistic effects. Through regional clustering, enterprises can more effectively share resources, knowledge, and technology, thereby accelerating the innovation process. As of June 2022, China boasts over 3,000 artificial intelligence companies, ranking second globally, with Beijing, Shanghai, and Shenzhen emerging as major hubs. These cities, characterized by advanced education, technology, and economic development, have facilitated the formation of three major artificial intelligence enterprise clusters in the Beijing-Tianjin-Hebei region, the Yangtze River Delta, and the Pearl River Delta, showcasing the trend of industrial clustering. These regional clusters not only promote efficient resource allocation but also stimulate interdisciplinary collaboration and technological exchange, fostering innovative thinking and collaborative effects within the industry. These clustered regions play an indispensable role in the healthy development and sustained innovation of the artificial intelligence sector, providing a solid foundation for China's leadership in the global artificial intelligence arena.

Source: Frost & Sullivan Analysis

Future Trends of China Artificial Intelligence Industry

The Application of Artificial Intelligence Tends to Be Widespread

- In the field of artificial intelligence (AI), the rise of large-scale AI models has ignited a wave of extensive AI application expansion. Generalized large models, such as ChatGPT, have sparked a surge of innovation in various verticals, with leading companies and startups actively exploring their application potential. Multiple industries, including finance, education, healthcare, law, autonomous driving, intelligent logistics, and security, have immersed themselves in the development of large-scale AI models. For instance, in the healthcare sector, IBM Watson Health has developed Watson for Oncology, an AI-driven tool that assists oncologists in identifying personalized, evidence-based cancer care choices. In the autonomous driving domain, Tesla has launched FSD Beta, a fully autonomous driving software enabling Tesla vehicles to navigate autonomously. Therefore, the widespread trend of AI applications not only expands the application domains but also brings innovation and value to various industries. As technology continues to evolve, artificial intelligence will continue to play a crucial role in all sectors.

AI-related Healthcare, Automobiles and Robotics Have Become Hot Spots for Investment

- The fields of healthcare, automotive, and robotics are rapidly emerging as prominent investment sectors within the artificial intelligence domain. According to statistics, in 2022, financing for AI-related companies exceeding RMB 100 million was primarily concentrated in areas such as autonomous driving, robotics, AI chips, AI in healthcare, and computer vision. In the realm of healthcare, AI technology finds widespread application in medical image diagnosis, precision medicine, and pharmaceutical research, ushering in a revolutionary transformation in healthcare. The automotive industry is actively exploring AI applications in autonomous driving, intelligent traffic management, and automotive manufacturing to enhance both traffic safety and travel convenience. Simultaneously, the adoption of robotic technology is on the rise in manufacturing, logistics, and service sectors, contributing to increased production efficiency and workplace automation. In the first seven months of 2023, the global robotics sector witnessed a total investment of USD 8 billion, with 48 financing events occurring in July 2023 alone. The heightened investment interest in these sectors underscores the transformative and innovative potential of AI technology across various domains, including healthcare, transportation, and manufacturing.

Source: Frost & Sullivan Analysis

Table of Content

Overview of Artificial Intelligence in Healthcare

- As a core member of the new infrastructure, AI can empower various industries. In the healthcare vertical, AI technology is not only applied at all levels of Government-side healthcare administration organizations and Business-side such as hospitals and pharmaceutical companies, but also able to create intelligent Customer-side products to enhance patient satisfaction.

AI-enabled Healthcare

Chronic Disease Management

- AI can perform intelligent follow-up after diagnosis and collect patients' monitoring records. It can not only provide patients with medication guide, but also alleviate the workload of doctors.

Disease Diagnosis and Treatment

- AI can support medical diagnosis and treatment, it can assist medical inquiry, provide doctors with knowledge searching, and recommend the treatment plans, etc.

Drugs R&D

- Pharmaceutical companies provide specific research data and information on biological targets, which AI then relies on to build models and screen drug candidates.

Equipment

- AI equipment can support physician during the whole process of diagnosis and treatment (e.g. post-diagnosis management, etc.).

AI Applications in Healthcare

Healthcare Institutions/Regulators

- Intelligent Healthcare /Management/Research
- Medical Treatment/Costs

Pharmacutical/Biotech Companies

- Pharmaceutical R&D/Distribution
- Participant Recruitment
- ADR Monitoring

Other Consumers

- Patients: Intelligent Medical Report/Ambulance, etc.
- Insurance Companies: Medical Data/Staffing, etc.

Source: Frost & Sullivan Analysis

Artificial Intelligence Core Technology in Healthcare

- The core technology of artificial intelligence include data acquisition, recognition and inference - acquisition: the computer acquires a large amount of structured data on health care; recognition: the computer acquires recognition capabilities by recognizing pictures, language, gestures, etc.; inference: the computer's ability to reason by understanding the relationship between people, places, time, etc..
- The future application of AI in the medical field is likely to combine more emerging technologies, such as quantum computing, nanotechnology, brain-computer interface, AR/VR and other interactive technologies. Therefore, companies with strong industry Know-How and customer base in AI will show a first-mover advantage in medical layout.

	AI Core Technology		Key Trends in AI Healthcare
Acquisition	• Big Data Collection • Internet of Things	• Rich data sources: China has a large population, a large data base, and rich diversity, which provides rich data sources for big data analysis and also provides a wide range of data sets for AI training and optimization of algorithm models. • Gradually increasing data accessibility: In recent years, the accessibility of electronic medical record data, medical image data, drug management information, medical insurance information, gene sequencing data, etc. has been growing explosively.	• Technology integration: In its current form, a mature product often has multiple technologies such as artificial intelligence, big data, IoT and deep learning.
Recognition	• Computer Vision • Audio Recognition • Natural Language Processing	• Take medical image data as an example: medical image data is huge in volume, high in dimensionality and complexity, and is typical unstructured data. Medical images account for more than 80% of all clinical medical data volume. • Convolutional neural network can well solve the extraction problem of image features by imitating multiple neural networks of human visual features, and its can downscale the huge image recognition problem and can read medical images after training.	• Cloud-based: Combine intelligent devices and cloud platforms to bring part of the business and data online and break the information isolation.
Inference	• Deep Learning • Edge Computing	• Deep learning is an important force of artificial intelligence technology, and currently speech recognition and computer vision are based on deep learning technology to complete. With the development of deep learning Resnet network structure in the image field, medical image analysis plays a bigger role in diagnosis and treatment. • Edge computing moves applications, data and services from the central node of the network to the logical edge node of the network for processing, closer to the user terminal device, which can speed up the processing and delivery of information and reduce latency.	• Data-driven: acquire massive medical big data, institutionalize it, and dig out the value behind these data to achieve data-driven technology evolution.

Source: Frost & Sullivan Analysis

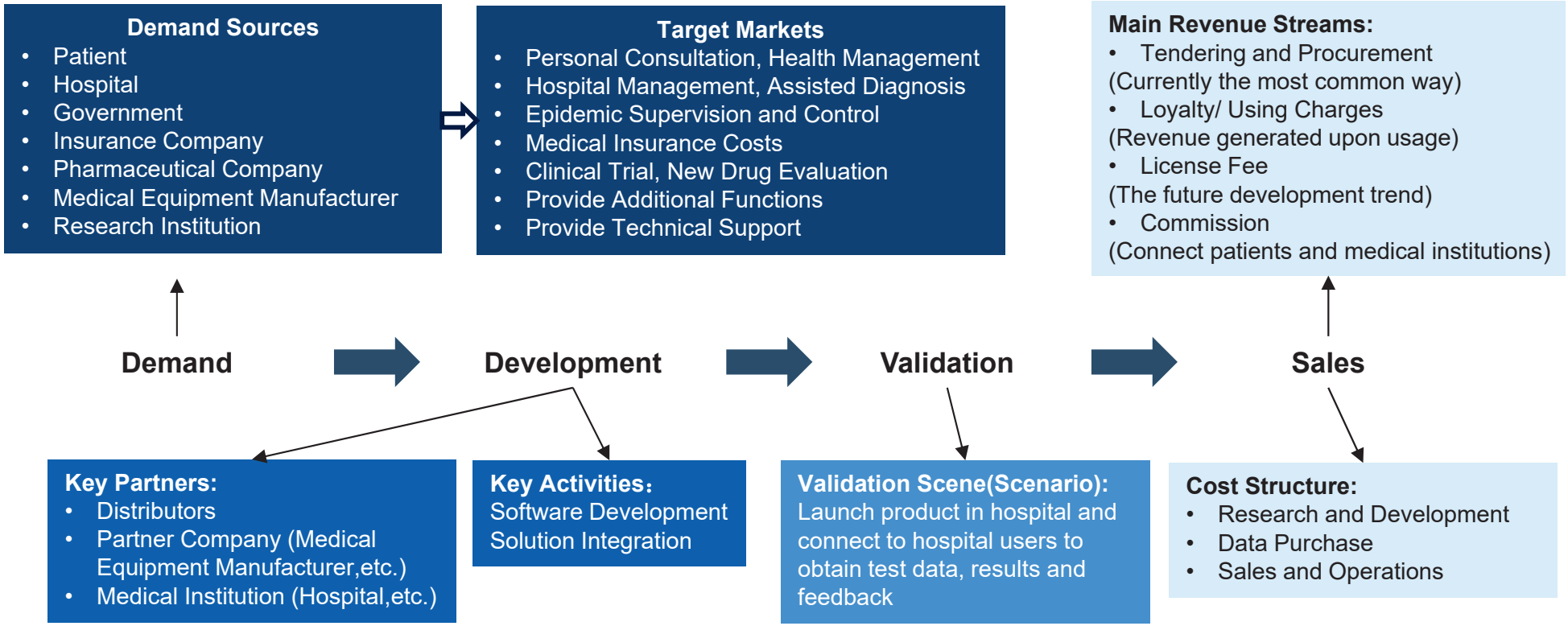
Major Players Analysis of AI Medical Large Models

	Major Players of AI Medical Large Models in China				
Company	科大讯飞 iFLYTEK | 讯飞医疗 Xunfei Healthcare	医联 MedGPT	Neusoft 东软医疗	JDH 京东健康 京医千询	灵医智惠
	Xunfei Healthcare	**MedLinker**	**Neusoft**	**JD Health**	**Baidu**
AI Medical Model	SPARK (讯飞星火医疗大模型)	MedGPT	Tianyi (添翼医疗领域大模型)	Jingyi Qianxun (京医千询)	Lingyi (灵医Bot)
Core Technology	Multi-modal machine learning, Deep learning of medical imaging, Attention mechanism, Data processing and analysis, etc.				
Launch Time	2023/10	2023/4	2023/6	2023/7	2023/9
Application in Healthcare	• **Healthcare institutions side:** assisted diagnosis and treatment, intelligent drug review, quality control of medical records and multimodal research of medical texts and images, etc. • **Patients side:** Interpretation of medical examination reports, quick inquiry of medical information, etc. • **Government side:** intelligent audit and supervision of medical insurance fund.	• **Pre-diagnosis:** realize the seamless connection from online consultation to medical examination; • **In-progress diagnosis:** assist doctors in diagnosis and medical decision; • **Post-diagnosis:** provide patients with medication guidance and management, intelligent follow-up, rehabilitation guidance, etc.	• **For doctors:** assist in completing medical records, making medical prescriptions, intelligent diagnosis of images, etc; • **For patients:** provide services like healthy diet, nutrition and exercise advice; • **For hospital management:** providing dialogic interaction and data insights for hospital administrators.	• **Pre-diagnosis:** guide patients to consultation through multimodal analysis of graphic and video information; • **In-progress diagnosis:** assist diagnosis, intelligent Q&A, can also be used as a scientific research assistant; • **Post-diagnosis:** monitor patient's health status and timely intervention in the patient's recovery process.	• **Intelligent health manager:** generate pre-questioning records, provide patients with customized one-stop intelligent services of diagnosis and treatment; • **Intelligent doctor's assistant:** Provide doctors with clinical decision support, image interpretation and treatment recommendation, etc. • **Intelligent enterprise services:** provide consulting services in the medical industry, etc.

Source: Frost & Sullivan Analysis

Business Model of AI Companies in Healthcare

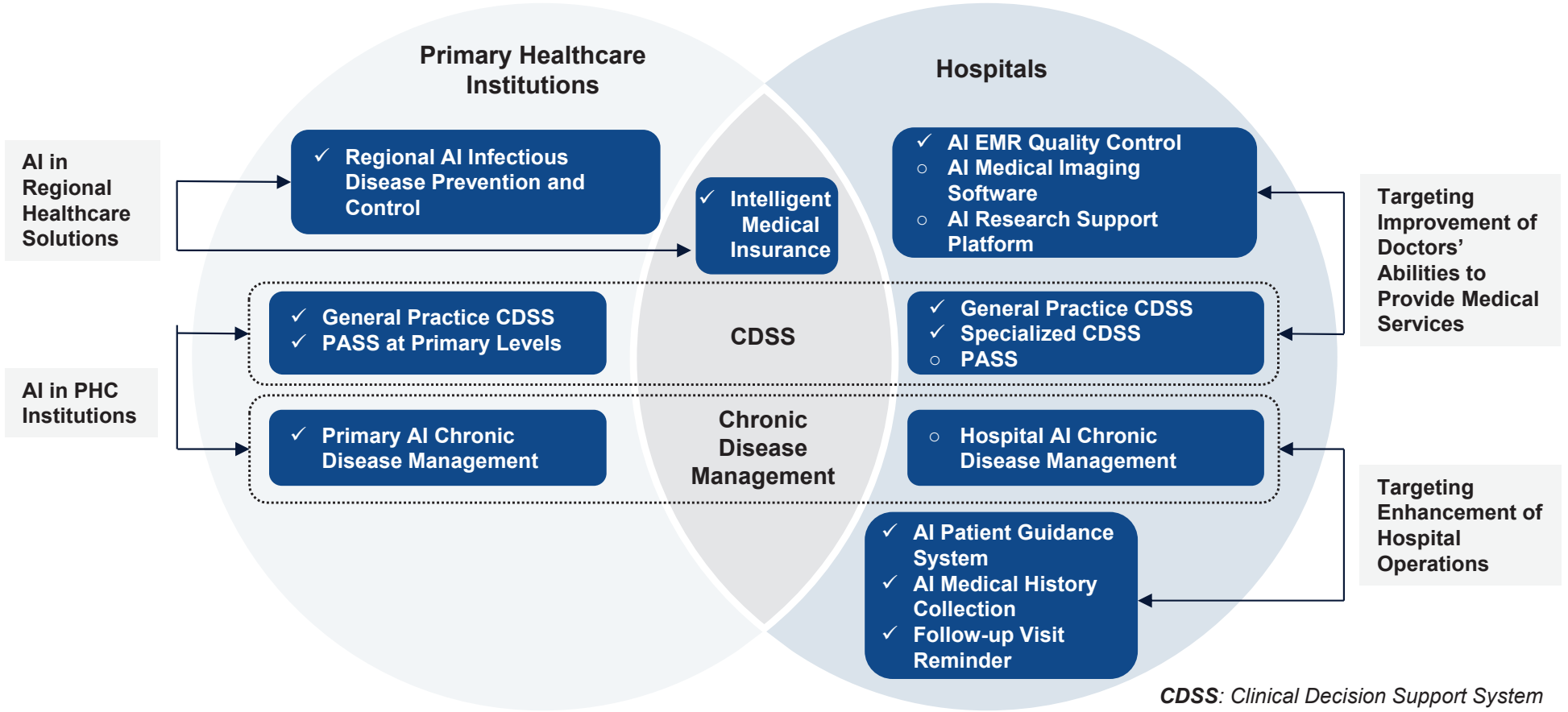
- The AI products or services often structurally go through four stages from initiation to implementation. The demand of the products or services can be from patients, hospitals, the government, insurance companies, and etc.
- During the development of the products or services, the AI companies may not have all the technologies or resources to complete them independently. For example, an high tech AI company focusing on software development may not have the same level of capability of medical device manufacturing. Therefore, partnerships are commonly seen in the AI healthcare industry.
- In the AI healthcare industry, the validation and sales are often interconnected as not all AI services or products are generating revenues. The AI companies are still at the phase of creating demand from hospitals and other institutions for their products and services. Thus, free or heavily discounted products and services are common.



Source: Frost & Sullivan Analysis

Application Scenarios Analysis of AI in Healthcare Institutions

- AI technology and experience accumulation in the medical field are becoming more and more mature, and relevant typical products have achieved multi-link and multi-scenario coverage, mainly used in primary medical institutions and hospitals at all levels. All participants in the medical industry chain (including medical administrative units, medical institutions at all levels, patients, etc.) have also benefited to varying degrees in the new medical pattern enabled by AI.
- In the hospital scenario, the main goals of AI application include improving doctors' diagnosis and treatment ability, improving hospital operation ability and patient experience. In the scenario of primary medical institutions, AI improves the quality of primary medical services by empowering general practitioners, and applies regional intelligent management to the prevention and control of infectious diseases, chronic disease medical insurance supervision and other fields, so as to realize the effective sinking of "intelligent medical resources" at the grassroots level and help the reform of the medical supply side.



✓ *Products/services provided by Xunfei Healthcare*

***CDSS**: Clinical Decision Support System*
***PASS**: Prescription Automatic Screening System*

Source: Public Companies' Filings, Company Official Websites, Frost & Sullivan Analysis

Major Application Scenarios of AI in Healthcare Institutions

AI in Hospitals

1 Assisted Diagnosis and Treatment

- Have authoritative medical knowledge base.
- Assist physician in patient examination, result analysis and intelligence assessment.
- Provide physician with knowledge search, treatment plan recommendation and reminder of surgical complications.

2 Medical Inquiry

- Medical triage robot and online triage system.
- Collect medical history based on multiple rounds of conversations with the patient and conduct a primary analysis of the patient's health condition with the technology of deep learning.

3 Hospital Management

- Structured medical records, graded treatment, DRGs intelligent system, expert system.
- Hospital openness and professionalism are gradually increasing.
- Provide a complete set of solutions to build AI hospitals.

4 Medical Imaging

- Lesion identification and labeling, 3D reconstruction, automatic target area outlining and adaptive radiotherapy.
- Opening up the medical imaging industry chain and third-party imaging centers will emerge in large numbers.

AI in Primary Healthcare Institutions

5 Chronic Disease Management

- With the high incidence of chronic disease and it has a characteristic of long treatment period, thus health management has become a trend.
- AI outbound call system can perform intelligent follow-up for patients after diagnosis.
- Automatically generate EMR for patients to monitor their conditions and provide medication guidance.

6 Infectious Disease Prevention and Control

- Publicity and popularization of epidemic prevention knowledge.
- Improve infectious disease analysis and early warning system.
- Assist experts in predicting the development trend of infectious diseases so as to impede the spread of pandemic.
- To help develop vaccine faster.

Source: Frost & Sullivan Analysis

Policy Analysis of AI in Healthcare Market (1/4)

Top-Level Design Policy of AI in Healthcare (1/2)

Policy	Release Date	Issuing Authority	Comments
Circular of the State Council on the Issuance of the Development Plan for a New Generation of Artificial Intelligence 《国务院关于印发新一代人工智能发展规划的通知》	2017-07	State Council	• It explicitly proposes to promote the application of new models of treatment with artificial intelligence and to build an intelligent medical system; to conduct research and new drug development based on artificial intelligence, and to promote the intelligence of pharmaceutical regulation.
Opinions on Deepening the Reform of the Medical Security System 《关于深化医疗保障制度改革意见》	2020-03	Communist Party of China Central Committee, State Council	• Supporting the development of new service models such as "Internet + Medicine"; vigorously promoting the application of big data; and implementing a multi-faceted and composite health insurance payment method based on payment by type of disease.
Outline of National Economic and Social Development and the Long-Range Objectives Through the Year 2035 《国民经济和社会发展第十四个五年规划和2035年远景目标纲要》	2021-03	State Council	• Promoting the development of a new generation of artificial intelligence, including the construction of open-source algorithmic platforms such as deep learning frameworks, learning reasoning and decision-making, and innovation in areas such as natural energy language recognition and processing.
Opinions on Promoting the Quality Development of Public Hospitals 《关于推动公立医院高质量发展的意见》	2021-06	State Council	• Promote the deep integration of new-generation information technologies such as cloud computing, big data, Internet of Things, blockchain and 5G with medical services. • Promote the construction of smart hospitals with electronic medical records, intelligent services and management and the standardization of hospital information, and promote the research, development and application of intelligent medical equipment such as surgical robots and intelligent assisted diagnosis and treatment systems.

Source: Government Notices, Frost & Sullivan Analysis

Policy Analysis of AI in Healthcare Market (2/4)

Top-Level Design Policy of AI in Healthcare (2/2)

Policy	Release Date	Issuing Authority	Comments
Data Security Law of the People's Republic of China 《中华人民共和国数据安全法》	2021-06	Order of the President of the People's Republic of China	• The State protects the data-related rights and interests of individuals and organizations, encourages the reasonable and effective use of data in accordance with the law, guarantees the orderly and free flow of data in accordance with the law, and promotes the development of a digital economy with data as a key element.
Universal Health Coverage Rules for the 14th Five-Year Plan 《“十四五”全民医疗保障规则》	2021-09	State Council	• Promote the rational use of artificial intelligence and other new technologies, improve the management of "Internet+Medicine and Healthcare" health insurance service designation agreements, and form a complete "Internet+Medicine" service price and health insurance payment policy.
Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Construction of a Unified National Market 《中共中央国务院关于加快建设全国统一大市场的意见》	2022-04	Communist Party of China Central Committee, State Council	• Accelerating the cultivation of the data factor market, and establishing and improving basic systems and standards for data security, rights protection, cross-border transmission management, trading and circulation, open sharing, and security certification.

Source: Government Notices, Frost & Sullivan Analysis

Policy Analysis of AI in Healthcare Market (3/4)

Landing Policy of AI in Healthcare (1/2)

Policy	Release Date	Issuing Authority	Comments
National Approach to the Management of Big Data Standards, Security and Services for Healthcare 《国家健康医疗大数据标准、安全和服务管理办法》	2018-07	National Health Commission of the People's Republic of China	• Promote the application of new modes and means of artificial intelligence treatment. Explore the construction of intelligent hospitals and develop human-machine collaborative surgical robots and other equipment. Promote the intelligence of pharmaceutical regulation.
Guiding Opinions on Improving the Prices of Medical Services and Payment Policies of Medical Insurance on the Internet Plus 《关于完善“互联网+”医疗服务价格和医保支付政策的指导意见》	2019-08	National Healthcare Security Administration	• Using AI technology for disease risk prediction, enabling medical image assisted diagnosis, clinical assisted treatment, intelligent health management, intelligent hospital management and virtual assistants.
Outline of Action for the Promotion of High-Quality Development of the Health Industry(2019-2022) 《促进健康产业高质量发展行动纲要（2019-2022年）》	2019-09	National Health Commission of the People's Republic of China, etc.	• Steadily promote the internal integration, sharing and opening up of data in education, healthcare, energy, public safety and other fields, support relevant enterprises and institutions to jointly carry out AI services around application scenarios, and encourage high-quality institutions to open up their AI service capabilities and resources to the local community.
Opinions on Supporting the Healthy Development of New Forms and Models to Activate the Consumer Market and Drive the Expansion of Employment 《关于支持新业态新模式健康发展激活消费市场带动扩大就业的意见》	2020-07	State Council	• Encourage the leading enterprises in AI segments to build open source, open platform, open AI technology research and development resources to the public, export AI technology service capabilities to the community, and help the growth of small and medium-sized enterprises.

Source: Government Notices, Frost & Sullivan Analysis

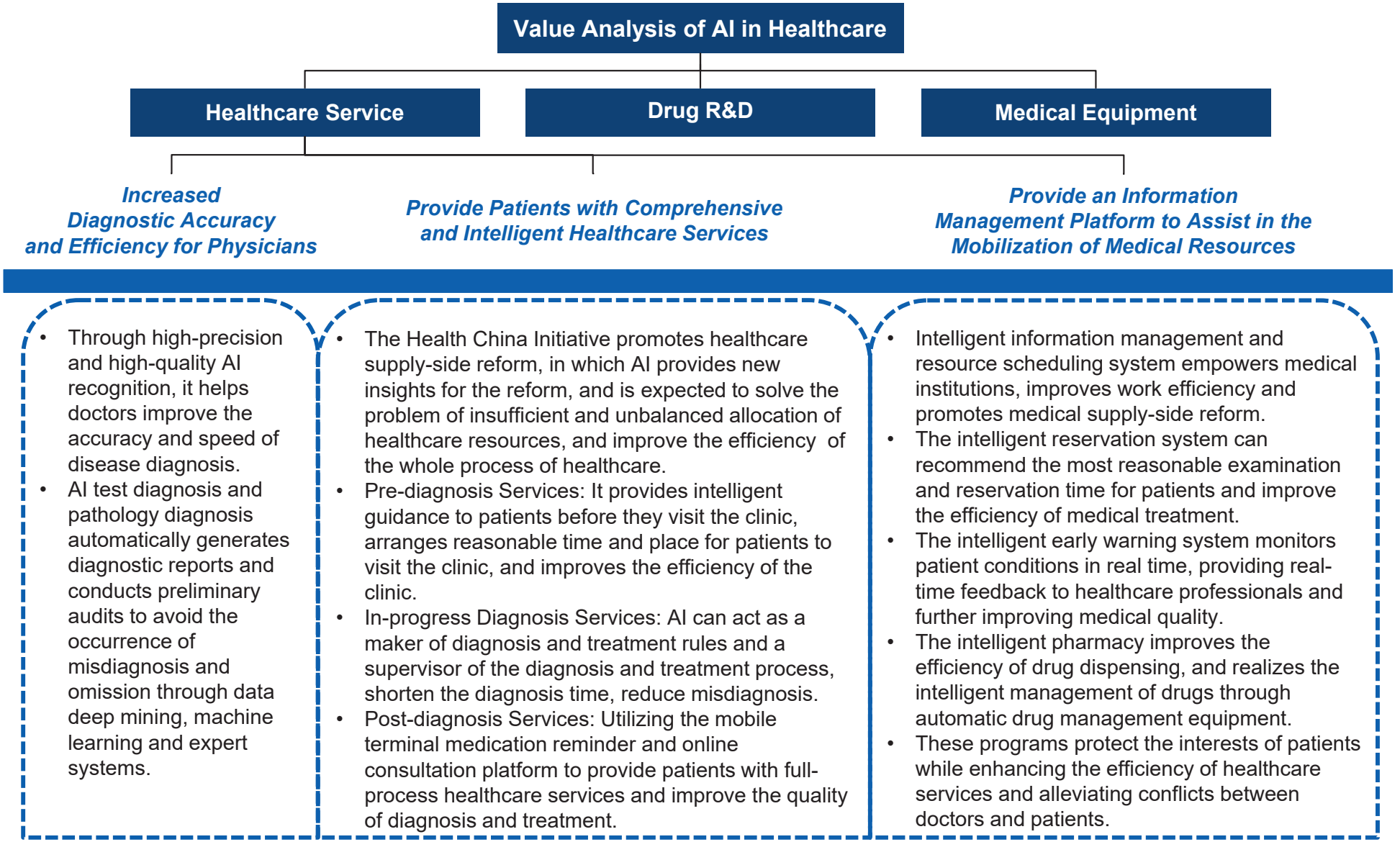
Policy Analysis of AI in Healthcare Market (4/4)

Landing Policy of AI in Healthcare (2/2)

Policy	Release Date	Issuing Authority	Comments
Guidelines for the Construction of a National Standard System for a New Generation of Artificial Intelligence 《国家新一代人工智能标准体系建设指南》	2020-08	National Development and Reform Commission and other five departments	• Further strengthen the supervision and management of AI medical software products and promote the development of the industry. • Contents involve: For AI medical software with low maturity in medical application, if it is used for assisted decision-making, it should be managed as the Class III medical equipment; If it is used for non-assisted decision-making, it should be managed as the Class II medical equipment.
Actions to Promote High Quality Development of Public Hospitals (2021-2025) 《公立医院高质量发展促进行动（2021-2025年）》	2021-01	NHC of PRC and SATCM	• In 2022, the average level of intelligent services in secondary and tertiary public hospitals nationwide will strive to reach Level 2 and Level 3, and the average level of intelligent management will strive to reach Level 1 and Level 2.
The Criteria System for Grading and Evaluating Hospital Intelligent Management (for Trial Implementation) 《医院智慧管理分级评估标准体系（试行）》	2021-03	National Health Commission of the People's Republic of China	• Improving the construction of electronic medical records, intelligent services, intelligent management "trinity" of intelligent hospital information system.
Guiding Principles for Defining the Categorization of Artificially Intelligent Medical Software Products 《人工智能医用软件产品分类界定指导原则》	2021-07	National Medical Products Administration	• Clarify the scope, management attributes and management categories of AI medical software products, and put forward clear requirements to further strengthen AI medical software products.
The 14th Five-Year Plan for Network Security and Informatization Construction for Medical Products Administration 《药品监管网络安全与信息化建设“十四五”规划》	2022-04	National Medical Products Administration	• Strengthen data resource sharing and big data application comprehensively implement the national big data strategic planning, strengthen drug regulatory data management and application, build a drug regulatory data sharing platform, effectively converge drug regulatory data resources nationwide, and realize data interconnection and interoperability between the national bureau and provincial bureaus.

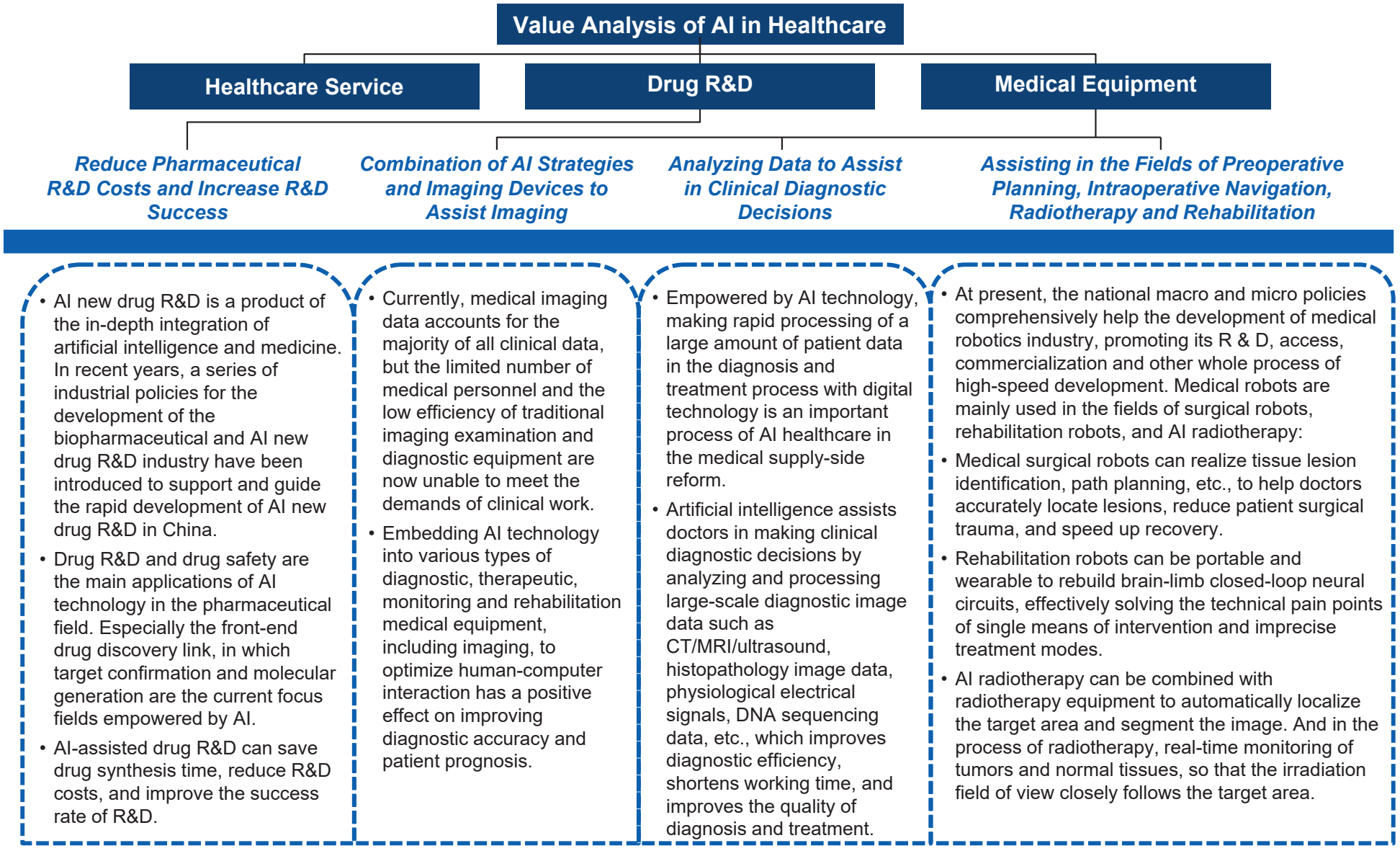
Source: Government Notices, Frost & Sullivan Analysis

Value Analysis of AI Healthcare (1/2)



Source: Frost & Sullivan Analysis

Value Analysis of AI Healthcare (2/2)



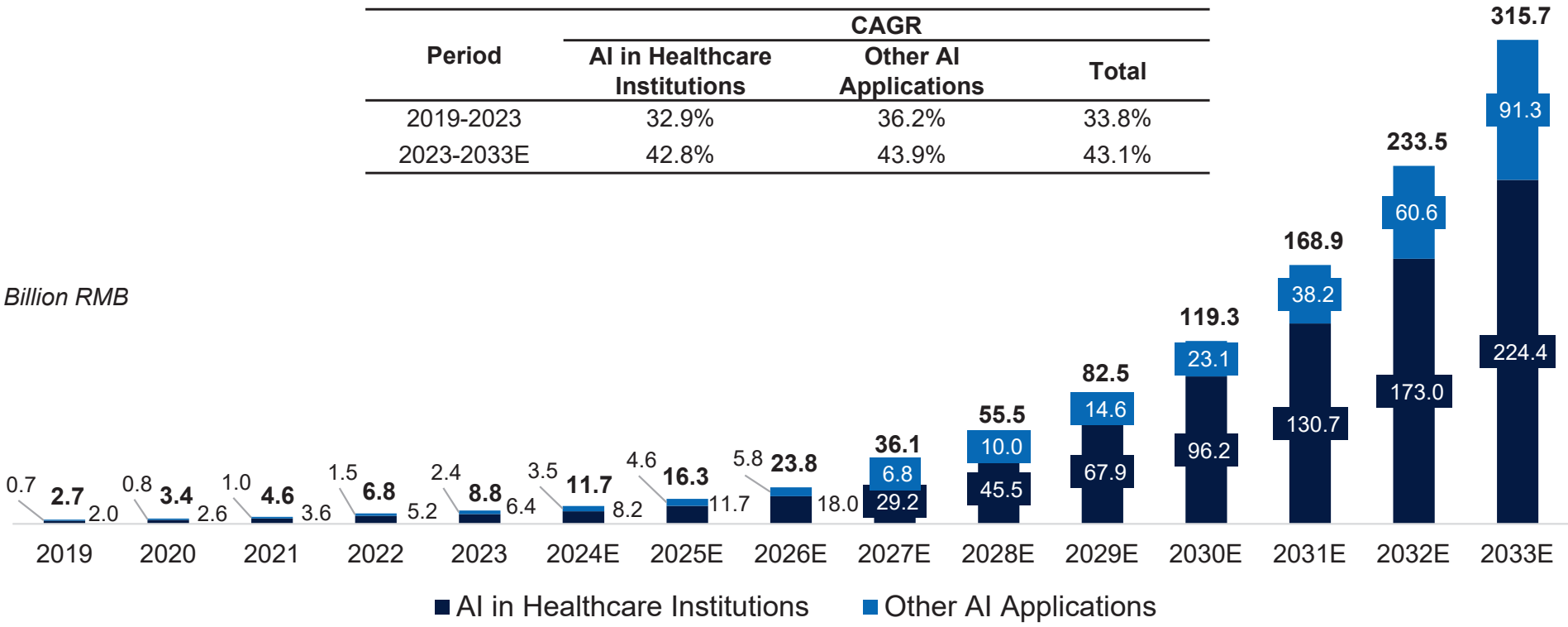
Source: Frost & Sullivan Analysis

Market Size of AI in Healthcare in China, 2019-2033E

- In 2023, China spent RMB 8.8 billion in total AI healthcare expenditure, compared to RMB 2.7 billion in 2019, showing a CAGR of 33.8% over this period. The total AI in healthcare market size is expected to further grow to RMB 315.7 billion in 2033 with a CAGR of 43.1% from 2023 to 2033. Xunfei Healthcare ranked first in the healthcare AI industry in terms of revenue with a market share of 5.9% in China in 2023.

Market Size of AI in Healthcare in China, 2019-2033E

Period	CAGR		
	AI in Healthcare Institutions	Other AI Applications	Total
2019-2023	32.9%	36.2%	33.8%
2023-2033E	42.8%	43.9%	43.1%



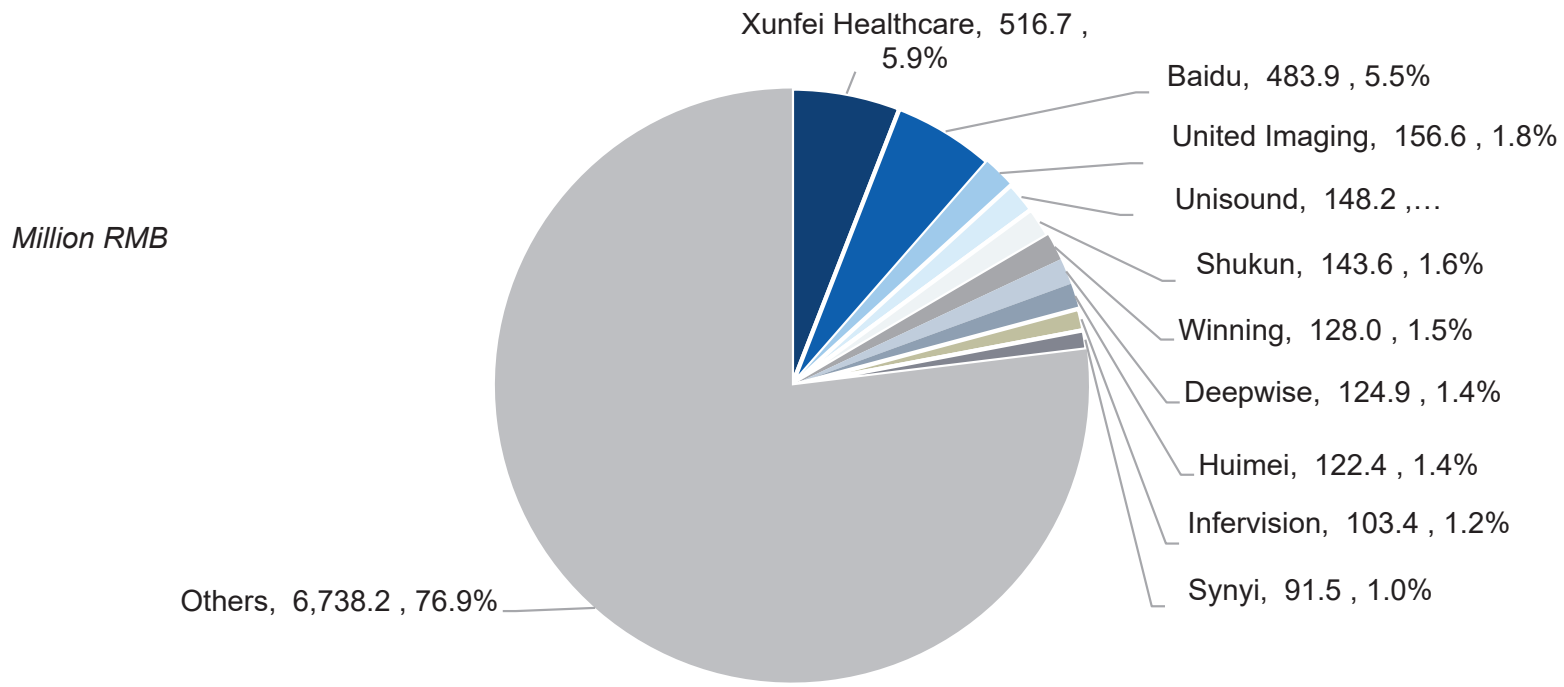
Note: Other AI Applications mainly include AI applications in pharmaceutical companies and biotech, and others. The AI market in pharmaceutical companies and biotech does not include computer-aided drug discovery (CADD) and sales of pharmaceutical products developed using AI. The others excluding AI in pharmaceutical companies and biotech mainly include patient-facing AI products and services, etc.

Source: Public Companies' Filings, China Health Statistical Yearbook, Frost & Sullivan Analysis

Breakdown of AI in Healthcare Market by Services Providers, 2023

- In 2023, Xunfei Healthcare ranks first in the market of AI in healthcare, with a market share of 5.9%, followed by Baidu at 5.5% of market share. Xunfei Healthcare, Baidu, United Imaging, Unisound, Shukun and other five major companies account for 23.1% of the AI in healthcare market, and the rest of players capture about 76.9% of market share in 2023.

Breakdown of AI in Healthcare Market by Services Providers, 2023



Note: The current AI healthcare market is still primarily focused on applications within healthcare institutions. Applications outside of healthcare institutions include AI usage in pharmaceutical companies, internet healthcare, physical examination institutions, consumer (C-end) applications, independent clinical laboratories (ICLs), and commercial insurance sectors. At present, these external applications, especially those beyond the pharmaceutical sector, are still in the early stages of development. The players in these areas are relatively fragmented, and significant revenue streams have yet to be formed.

Source: Frost & Sullivan Analysis

Key Difference Analysis of Products and Solutions offered by Major Market Players in China AI Healthcare Market (1/3)

- In terms of healthcare AI industry in China, the major players can be classified into two categories by healthcare-related business scope: (i) comprehensive healthcare AI products/solutions providers, including pure healthcare AI companies and others; and (ii) healthcare AI products/solutions providers specialized in CDSS or AI imaging.
- Xunfei Healthcare Technology Co. Ltd. and Unisound AI Technology Co., Ltd. are two representative companies in China whose healthcare-related business scope focuses on healthcare AI products and solutions.

Comprehensive Healthcare AI Products/Solutions Providers		Specialized Healthcare AI Products/Solutions Providers	
Pure Healthcare AI Companies	**Other Companies***	**Companies Specialized in CDSS**	**Companies Specialized in AI Imaging**
• **Xunfei Healthcare Technology Co. Ltd.,** who offers AI-empowered healthcare solutions including General Practice CDSS, Medical Insurance Administrative Solutions, Chronic Disease Management Tools, AI-assisted Patient Management and AI-assisted Mobile Doctor Workbench.	• **Baidu Inc.** provides products/solutions such as Medical Big Data Processing, Fundus Image Analysis system, Intelligent Pre-diagnosis Assistant.	• Beijing Huiyun Technology Co., Ltd.	• Shanghai United Imaging Healthcare Co.. Ltd. • Shukun Technology Co., Ltd.
• **Unisound AI Technology Co., Ltd.,** who provides AI-empowered healthcare solutions such as medical record voice entry, medical record quality control, single-disease quality control and medical insurance payment management.	• **Winning Health Technology Group Co., Ltd.** offers healthcare informatization products and Internet medical products.	• Shanghai Synyi Medical Technology Co. Ltd.	• Infervision Medical Technology Co., Ltd. • Beijing Deepwise Science and Technology Co., Ltd.

Note: Other comprehensive healthcare products/solutions providers are companies whose primary business layout includes segments other than AI healthcare.

Source: Frost & Sullivan Analysis

Key Difference Analysis of Products and Solutions offered by Major Market Players in China AI Healthcare Market (2/3)

Companies	CDSS	Chronic Disease Management	Hospital AI Services	Post-Discharge Management	Medical Insurance Administrative Solutions	AI Imaging
Xunfei Healthcare Technology Co. Ltd.	✓	✓	✓	✓	✓	✓
Unisound AI Technology Co., Ltd.	✓	-	✓	✓	✓	-
Baidu Inc.	✓		✓	✓		✓
Winning Health Technology Group Co., Ltd.	✓	-	✓	-	✓	✓
Beijing Huiyun Technology Co., Ltd.	✓	-	-	-	-	-
Shanghai Synyi Medical Technology Co. Ltd.	✓	-	-	-	-	-
Shanghai United Imaging Healthcare Co.. Ltd.	-	-	-	-	-	✓
Shukun Technology Co., Ltd.	-	-	-	-	-	✓
Infervision Medical Technology Co., Ltd.	-	-	-	-	-	✓
Beijing Deepwise Science and Technology Co., Ltd.	-	-	-	-	-	✓

Source: Frost & Sullivan Analysis

Key Difference Analysis of Products and Solutions offered by Major Market Players in China AI Healthcare Market (3/3)

Manufacturer	Xunfei Healthcare	HM· Dr. Mayson	SNYNI AI	Baidu Ling Yi Zhi Hui
Launch Year	2016	2015	2016	2018
Targeted Customers	• Mainly primary healthcare institutions • Hospitals	• Mainly Class III hospitals • Used to provide basic CDSS products for primary healthcare institutions	• Mainly Class III hospitals in Jiangsu, Zhejiang, Shanghai	• Smart Hospital: Regional comprehensive hospitals or Class II hospitals • Ai Zhu Yi (爱助医): Primary healthcare institutions
Product Versions	1. General Practice CDSS product for primary healthcare institutions 2. General Practice CDSS product for hospitals 3. Specialized disease version	1. General Practice CDSS for hospitals 2. General Practice CDSS for primary healthcare institutions 3. Specialized disease version	1. General Practice CDSS suitable for all departments in hospitals 2. Specialized disease version	1. General Practice CDSS for hospitals 2. General Practice CDSS for primary healthcare institutions 3. Specialized disease version
Covered Disease Areas by General Practice Version	• The system provides diagnostic assistance for 95% of diseases (i.e., more than 900 diseases) common in primary care level.	• The standard primary level version covers 2,000+ diseases • The standard hospital version provides diagnostic assistance for 80% of diseases common in general hospitals.	• The standardized version covers topics of over 1,400 diseases, 2,600 test items, and 30,000 medications.	• Ai Zhu Yi (爱助医): The system covers 300+ common diseases at primary level. • Smart Hospital: The system covers 5,000+ diseases of general practice.

Covered Disease Areas by Specialized Version	• 1,095 common disease areas in 33 departments including:
	  • Obstetrics
	  • Oncology
	  • Pan-vascular
	  • Gastroenterology
	  • Orthopedics
		• ICU related diseases
		• Oncology
		• VTE
			• VTE
			• Septicemia
				• COPD
				• Cardiovascular areas such as VTE

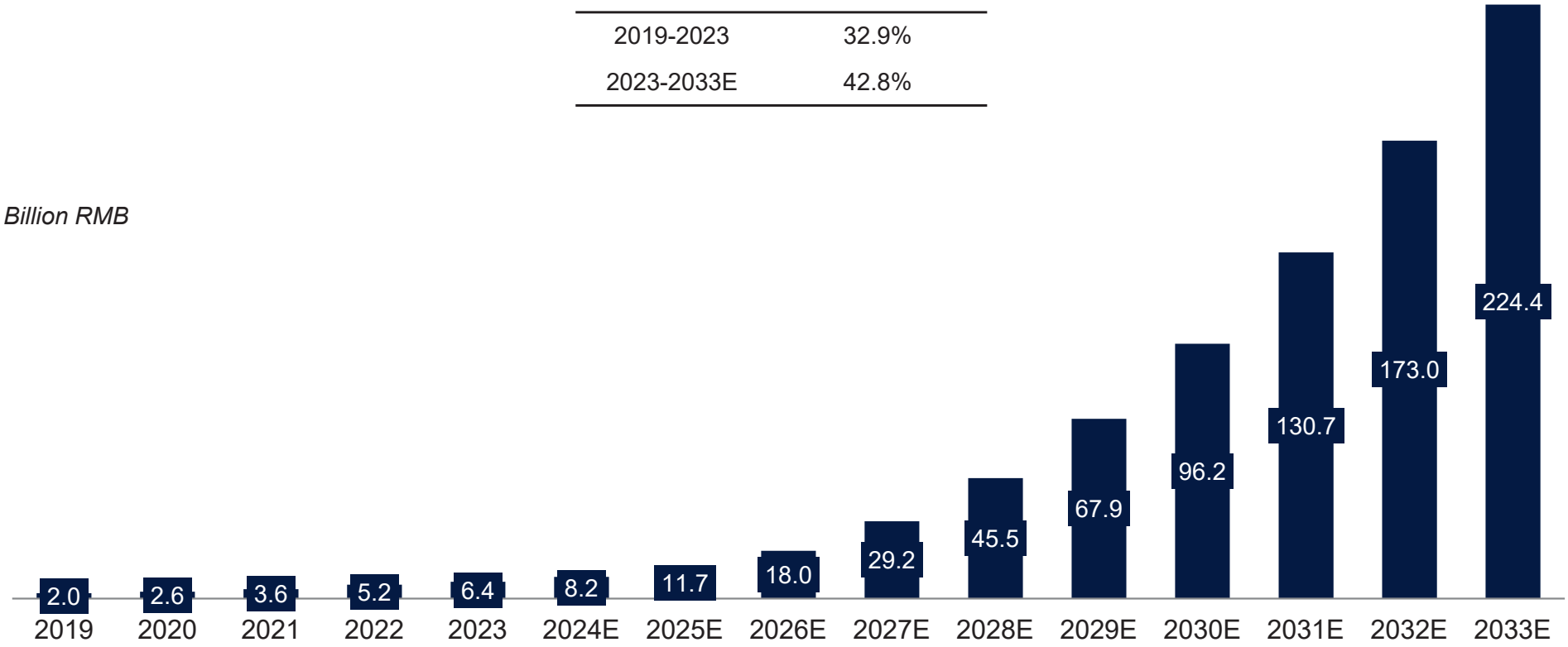
Source: Frost & Sullivan Analysis

Market Size of AI in Healthcare Institutions in China, 2019-2033E

- The market size of AI in healthcare institutions in China increased from RMB 2.0 billion in 2019 to RMB 6.4 billion in 2023, representing a CAGR of 32.9%. In 2033, the market is expected to further grow to RMB 224.4 billion with a CAGR of 42.8% from 2023 to 2033.

Market Size of AI in Healthcare Institutions in China, 2019-2033E

Period	CAGR
2019-2023	32.9%
2023-2033E	42.8%

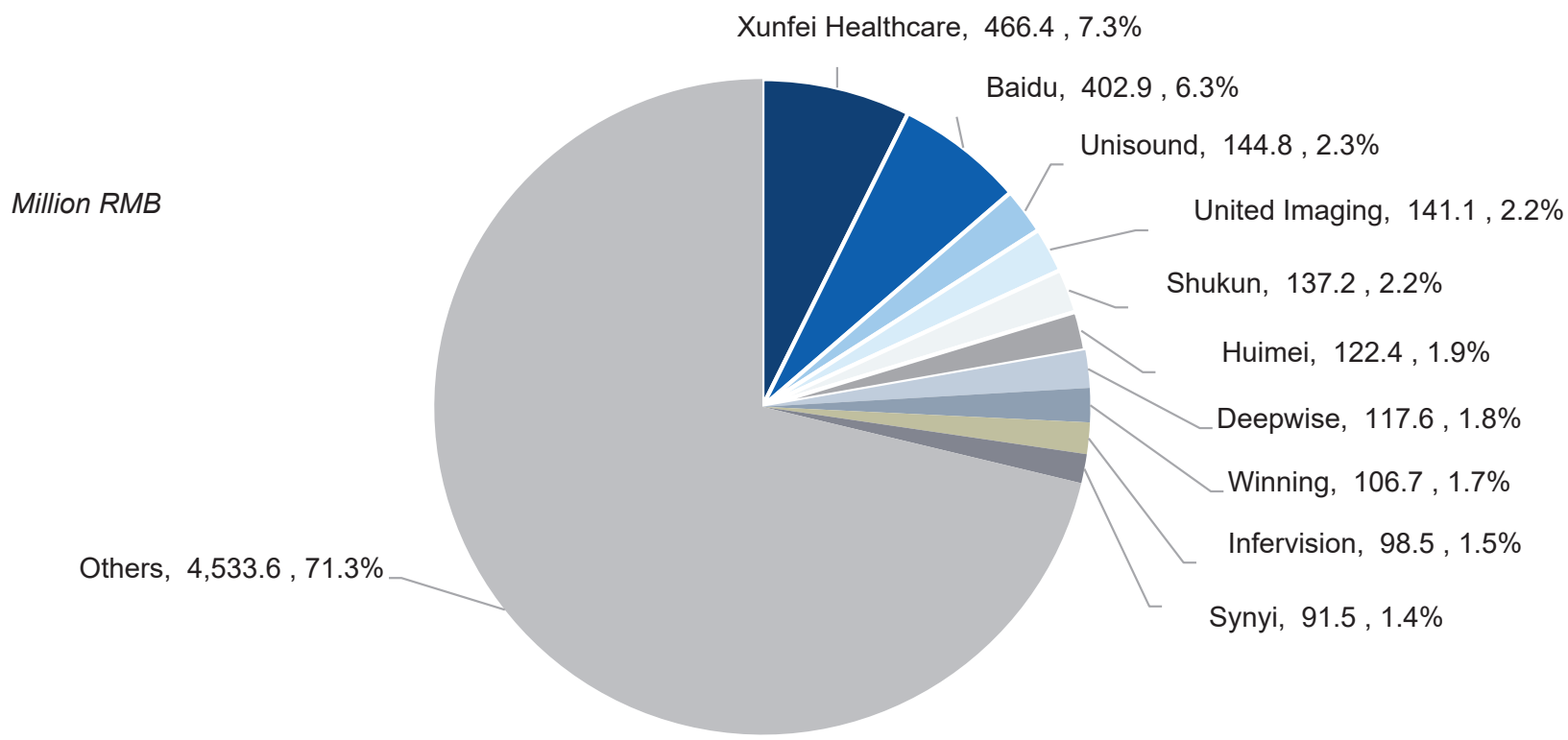


Source: China Health Statistical Yearbook, Company Official Websites, Frost & Sullivan Analysis

Breakdown of AI in Healthcare Institutions Market by Services Providers, 2023

- In 2023, Xunfei Healthcare ranks first in the market of AI in healthcare institutions, with a market share of 7.3%, followed by Baidu at 6.3% of market share. Xunfei Healthcare, Baidu, Unisound, United Imaging, Shukun and other five major companies account for 28.7% of the AI in healthcare institutions market, and the rest of players capture about 71.3% of market share in 2023.

Breakdown of AI in Healthcare Institutions Market by Services Providers, 2023



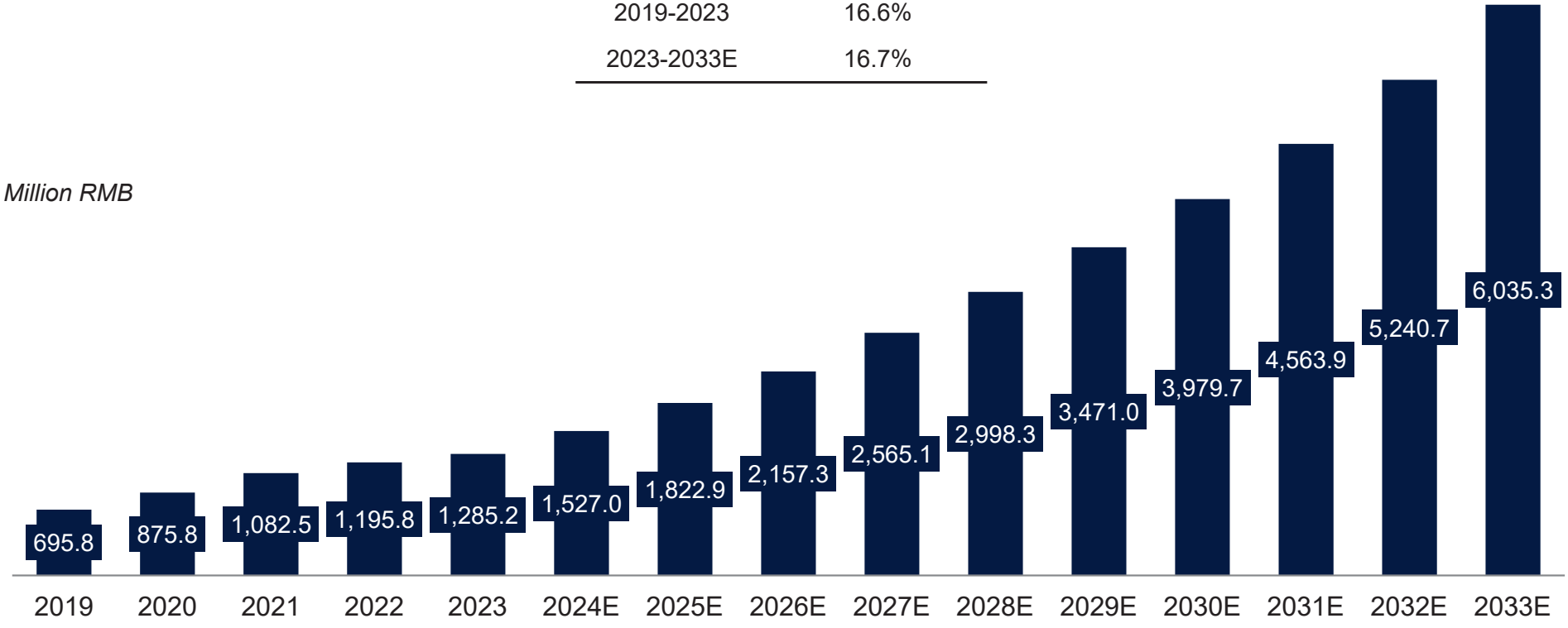
Source: Frost & Sullivan Analysis

Market Size of CDSS in China, 2019-2033E

- CDSS, playing an important role as an AI-powered physician assistant during medical diagnosis, is one of the most typical AI healthcare applications. The China CDSS market size increased from RMB 695.8 million in 2019 to RMB 1,285.2 million in 2023, representing a CAGR of 16.6% during this period. In 2033, the market is expected to further grow to RMB 6,035.3 million with a CAGR of 16.7% from 2023 to 2033.

Market Size of CDSS in China, 2019-2033E

Period	CAGR
2019-2023	16.6%
2023-2033E	16.7%



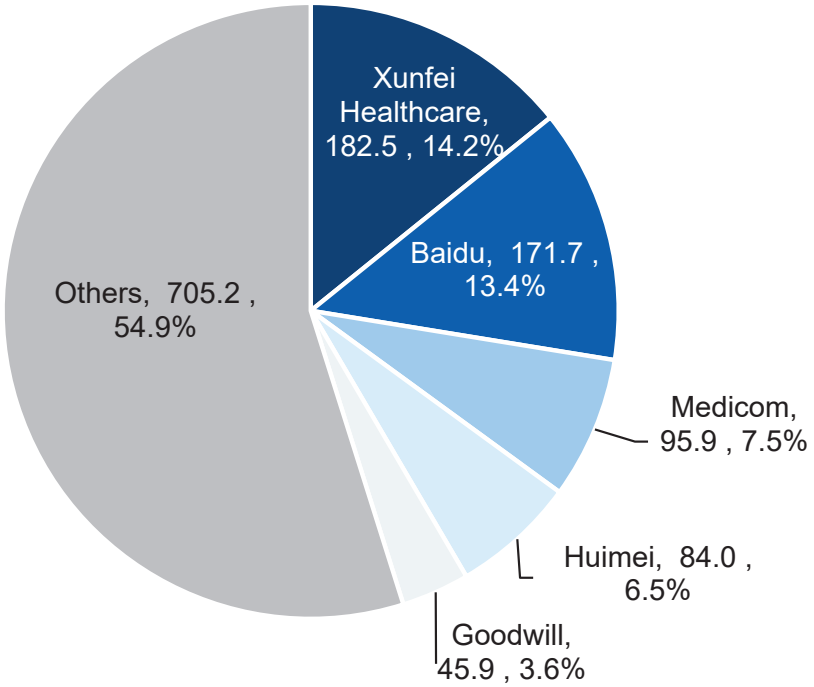
Source: Frost & Sullivan Analysis

Breakdown of China CDSS Market by Providers, 2023

- In 2023, Xunfei Healthcare ranks first in China CDSS market with the share of 14.2%, followed by Baidu at 13.4% of market share and Medicom at 7.5% of market share. Xunfei Healthcare, Baidu, Medicom, Huimei, and Goodwill account for 45.1% of the CDSS market and the rest of players capture the share of 54.9% in 2023.

Breakdown of China CDSS Market by Providers, 2023

Million RMB



Source: Frost & Sullivan Analysis

Challenges and Risks Analysis of AI in Healthcare Market in China

Lack of Unified Regulatory Standards	• AI technology must meet objective criteria to ensure reliability, traceability, privacy, and other requirements. The data used to train AI generally comes from the medical institutes, but such highly sensitive issues regarding patients' privacy should be highly regulated. Currently, the regulations on the use of healthcare big data and algorithms in China are still imperfect and lagging.
Fair Benefits Issues	• Medical AI is a new and high-tech medical technology, which is still a scarce resource at the current stage. In addition, the research and development cost of medical AI technology is high, so it charges high fees in the clinical application and is usually not covered by the medical insurance, which makes only a minority of the people can access to the medical AI technology.
Medical Safety Issues	• Technically, the development of domestic medical AI is still at the beginning stage. The product performance is not stable, the corresponding standards are still lacking, and the safety remains to be verified. It is still needed improvement in practice. • Currently, medical AI is just a machine or a program that must rely on doctors to control or make the final decisions. At the beginning of using AI product, doctor may cause machine breakdown due to the unskilled operation and may even cause serious consequences.
Bias Issues	• Although based on algorithms and big data, AI program is not completely objective and impartial, and may have implicit bias or discrimination which may come from the value preferences of the algorithm designer, from the biased training data, or from sampling bias of the input data. It may result in discriminatory treatment of certain groups of people in medical evaluation and may even lead to the medical safety accidents.

Source: Frost & Sullivan Analysis

Growth Drivers of AI in Healthcare Market in China (1/2)

Advancement of AI Technologies and AI-related Hardware	• The advancement of AI technologies such as machine learning and deep learning, driven by the increased amount of data collected, can accordingly enhance the capability of AI products. Moreover, the development of the supplementary hardware can also contribute to the capabilities of the AI-enabled healthcare services. The better AI healthcare services can better address the pain points of the healthcare market, thus leading to a fast growth of the market.

Favorable Policies	• The government has been promoting the development of AI in all industries, with the healthcare market being one of the most important ones. In《National hospital information construction standards and norms (for trial implementation)》by NHC in 2018, it was encouraged that AI technology be used for disease risk prediction, enabling medical image assisted diagnosis, clinical assisted treatment, intelligent health management, intelligent hospital management and virtual assistants.
	• For hospitals:
	  • In 2018, the government proposed *the Administrative Measures for Grading Evaluation of Application Level of Electronic Medical Record System (Trial)《电子病历系统应用水平分级评价管理办法（试行）》*. It stipulates the standards for different grades of EMR system and proposed specific requirements for tertiary hospitals. Many AI applications, including CDSS and intelligent hospital management system, are directly related to the grade evaluation.
	• For primary healthcare institutions:
	  • As a result of the COVID pandemic, the Chinese government is determined to balance the medical service capabilities difference between hospitals and primary healthcare institutions and have been issuing a large number of policies to promote the service capabilities of primary healthcare institutions. Such policies include recommendation of informatize primary healthcare system and of implementation of AI and 5G technologies.

Source: Frost & Sullivan Analysis

Growth Drivers of AI in Healthcare Market in China (2/2)

The Deficiency of Medical Resources	• From the supply side, there exists extreme deficiency for quality doctors and medical resources. According to the most recent statistics from WHO, the 2022 doctor to population ratio is 1:418 in China and 1:282 in the U.S., representing around 1.5 times of gap. Meanwhile, the medical resource distribution is severely imbalanced. There are 3,523 tertiary hospitals in 2022, accounting for 9.5% of all hospitals, but they are responsible for over 2.2 billion visits, which is 58.4% of the total number of hospital visits in 2022. The medical expertise of doctors in the primary healthcare institutions can vary tremendously. Some of the primary institution doctors are in urgent need for support such as AI clinical decision support systems.
Massive Healthcare Demands Due to Aging and Chronic Diseases	• The financial burden of chronic disease in recent years has driven an increase in demand for chronic disease management. As an effective technology to be utilized in chronic disease management, AI application in chronic disease management is expected to experience exponential growth in recent years. • In response to the trend of aging, AI technology can provide strong support for the huge medical demand by improving the quality and efficiency of healthcare services, including pre-diagnosis intelligent guidance services, in-diagnosis auxiliary diagnostic and treatment systems for complex geriatric diseases, and post-diagnosis intelligent follow-ups so as to empower the whole process of healthcare services for elderly patients.

Source: Frost & Sullivan Analysis

Future Trends of AI in Healthcare Market in China

Providing Value-Oriented Healthcare to Patients	• The global pandemic has instilled the idea of health management in the general public, which places the entire healthcare industry on a fast-growing track. Moreover, the improved health awareness also specifically altered people's idea of health management from passive management to active management. • Healthcare industry participants can provide value-oriented solutions for patients and build systems that can objectively measure outcomes and quality evaluations to make pay-for-performance evidence-based.
Broader Application of AI	• With the support of the unceasingly advancing AI technologies, the application of AI in the healthcare field is becoming increasingly innovative, ranging from drug development, hospital management system improvement, personal AI healthcare products, to AI information service for healthcare insurance. As more and more application scenarios are discovered and services implemented, more data, which can be utilized to improve AI products and services, is generated as well. In the future, the accumulated data will lead to new AI services and products in healthcare.
Improved AI Healthcare Accessibility for the Popularity of Mobile Apps	• Under the support of AI and 5G technologies, the progress of information implementation in medical institutions is unprecedentedly fast.Increased efficiency and accurate decision-making avoid waste and reduce supply-side costs such as drugs and hospital operations. The AI healthcare providers can perform dynamic risk pricing based on disease and patient models to enhance payment capabilities and improve the user experience for doctors and patients.
Development of New Technologies	• Ever since 2018, the progress of development of intelligent application in the medical field has been accelerating. Based on AI, big data, marginal computing, and 5G, applications such as CDSS, AI imaging emerged after the combination of different technologies. In the future, new technologies from other fields will be added to the mix, where all types of technologies intermingle into new ones to create new medical demands or address unsolved or new pain points in the medical field.

Source: Frost & Sullivan Analysis

Entry Barriers of AI in Healthcare Market in China (1/2)

Talent Barriers	• Since AI industry is a technology-intensive industry, it requires professionals with accumulated experience and integrated application of various cross-technologies. It is especially lack of compound talents with multi-disciplinary talents. • AI industry needs to develop products with different characteristics for specific applications which requires professionals to be highly involved with the process and have strong learning abilities. Therefore, long-course in training talents, especially with healthcare background, is essential.

Technical/ Product Design Barriers	Technical/ product design barriers are focused on medical image recognition, medical data comprehension capabilities and medical data insight capabilities:
	• For Primary Healthcare Institutions:
	  • Primary healthcare institutions require expansive service coverage including rural areas. AI healthcare services for primary healthcare institutions need to be able to cover a large areas and doctors from different backgrounds and with different habits.
	  • A user-friendly interface design for doctors with less IT proficiency is necessary in primary healthcare institutions since doctors are not expected to have great experience working with AI equipment. Smaller companies may not have the expertise in user interface designs.
	• For Hospitals:
	  • AI application in the medical field highly depends on the medical knowledge graph developed by the service providers. Products such as CDSS, AI imaging, voice EMR, and most of other AI applications in hospitals rely on an accurate and complete base of medical knowledge. The accumulation of medical knowledge is difficult to achieve in a short term by new entrants.

Source: Frost & Sullivan Analysis

Entry Barriers of AI in Healthcare Market in China (2/2)

Company Reputation Barrier	• As the AI Healthcare industry involves serious medical services that are related to patients' health and even lives, the reputation of service providers must be good. For AI projects in primary healthcare institutions, the reputation of service providers is even more vital as AI medical projects at primary level involves mainly public health projects and CDSS projects, which involves patient privacy and partnerships with the government. Small companies or new entrants are less likely to be trusted by the government.

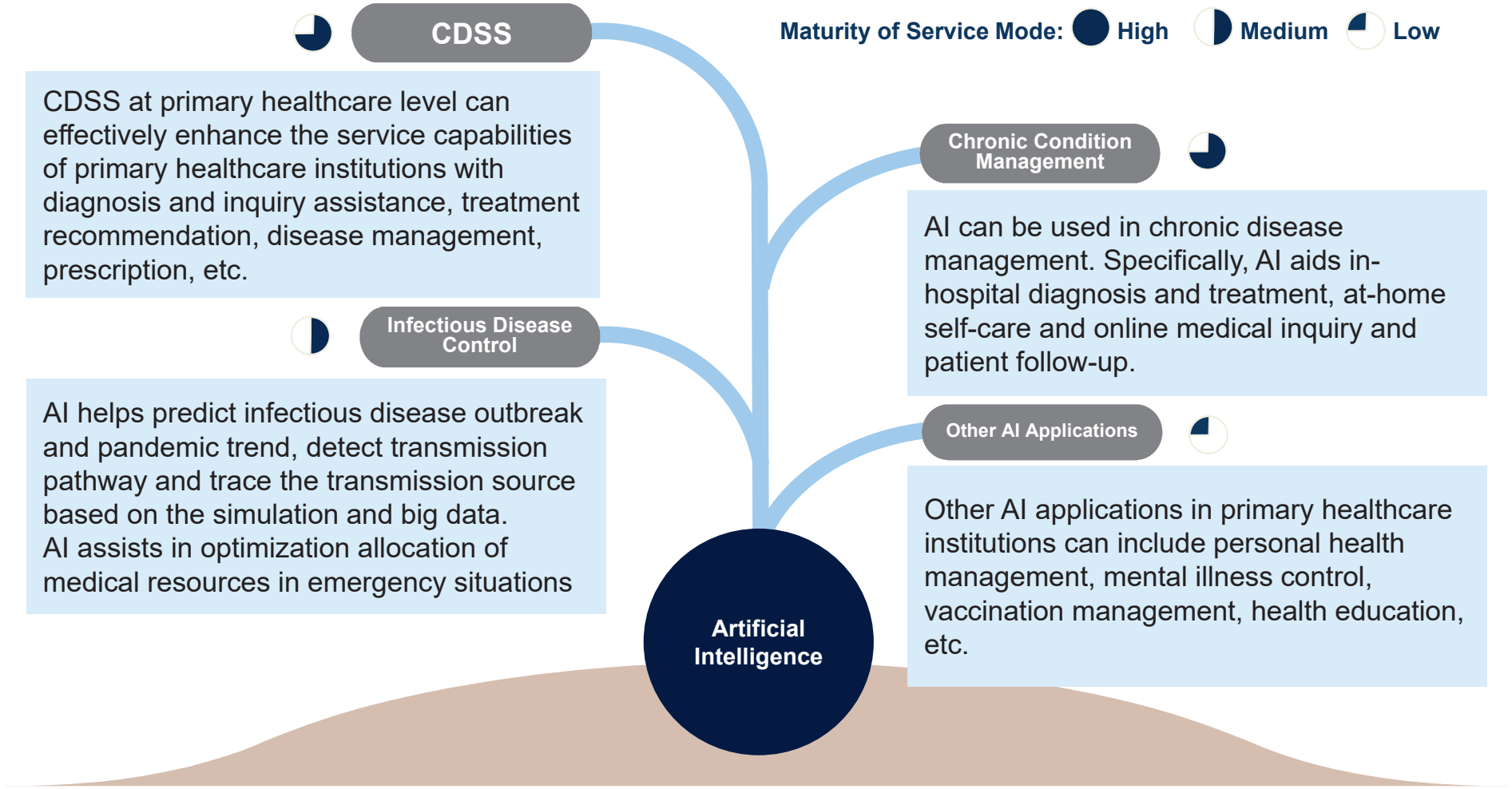
Capital Barriers	• Overall heavy capital requirement: In order to increase their core competitiveness, healthcare AI enterprises may need to invest a large amount of capital in production, R&D, brand promotion, channel construction and product services. It is difficult for the enterprises with poor financial capabilities to operate their funds efficiently and achieve further development in the industry.
	• The investment in AI healthcare is usually long-term
	  ◦ In primary healthcare institutions: projects of AI applications in primary healthcare institutions are often government projects, which usually have a long payback period. New entrants or small companies would not be able to endure such a long payback time.
	  ◦ In hospitals: some AI products require a long development period due to a strict need for data accumulation. For instance, As hypertension condition varies with seasons and an AI system for hypertension requires data of one year to accurately project the conditions of hypertension patients. Small companies would not be able to invest so much in R&D for so long.

Source: Frost & Sullivan Analysis

Table of Content

Overview of AI Applications in Primary Healthcare Institutions

The utilization of AI in primary healthcare institutions mainly depends on two facts: 1. the need to improve the service capabilities of primary healthcare institutions; 2. the easy accessibility of primary healthcare institutions and their potentials to deliver the “last-mile” medical services. Typical application scenarios of AI at primary healthcare level include CDSS, chronic condition management, infectious disease control, and other scenarios such as mental illness control, vaccination management and health education.



Source: Literature Research, Frost & Sullivan Analysis

Analysis of Pain Points of Primary Healthcare Services and Value of AI in Primary Healthcare Institutions

	Pain Points of Healthcare Services in Primary Healthcare Institutions	Value Analysis of AI in Primary Healthcare Institutions
Limited Level of Medical Personnel and Insufficient Medical Resources	• There is a wide gap between the medical resources of primary medical institutions and those of higher-level hospitals; not only is the level of primary medical personnel limited, with poor diagnostic accuracy and unstandardized use of medication, but also, there is a shortage of medical equipment and medicines. These factors have made it difficult for primary healthcare to diagnose and treat, conduct examinations and tests and take medication, resulting in a crisis of trust between doctors and patients, which has increased the burden in high-grade hospitals, and made the conflict between doctors and patients even more pronounced.	• Penetrating artificial intelligence medical treatment into primary medical institutions can improve diagnosis and treatment accuracy and enhance the quality of medical services to a certain extent. Ease the doctor-patient trust crisis by reducing diagnosis and treatment errors. • With general practice CDSS, for example, AI can enable primary medical staff to improve diagnosis and treatment, reduce misdiagnosis rates, provide general, efficient and accurate diagnostic tools for primary care, assist doctors in making decisions on whether a patient needs to be referred, and facilitates the sinking of high-quality healthcare services to the grassroots level.
Inadequate Triage	• Primary care organizations have limited capacity and therefore do not have the trust of patients. • At the same time, patients do not have enough knowledge of disease patterns and are skeptical of the service capacity of primary medical institutions. • As the income level of the population rises, the tendency to seek medical treatment is higher, larger, superior and heavier, making it impossible to realize the principle of "primary medical care".	• AI healthcare is expected to solve the problem of insufficient and unbalanced allocation of medical resources, and improve the efficiency and experience of the whole process of healthcare. • Provide consultation advice through intelligent guidance to help patients find suitable hospitals and departments more quickly and accurately, and fully utilize the role of first diagnosis and first treatment for common and frequent diseases. • Provide preliminary diagnostic advice to patients through remote diagnosis.
Inability to Meet Chronic Disease Management Needs	• Chronic diseases have become a major public health problem affecting the economic and social development of the country. In the face of the increasing number of patients with chronic diseases, the traditional chronic disease management model cannot meet the huge management demand. • Problems such as poor equipment, low manpower, and low level of computerization in primary healthcare institutions are becoming more and more prominent, which affects the efficiency of chronic disease management to a great extent.	• In response to the demand for chronic disease management, AI healthcare can establish personal electronic health records for the chronic disease population through a variety of intelligent health testing equipment, provide early screening of chronic disease, early warning of chronic disease risk and comprehensive intervention, promote the sinking of high-quality healthcare resources, and enhance the fairness and accessibility of medical and healthcare services.

Source: Frost & Sullivan Analysis

Entry Barriers to AI in Primary Healthcare

Data Quality and Access Barriers	• Data quality barriers: Artificial intelligence technology requires a large amount of complete and accurate data for training and optimization. However, data at primary healthcare institutions are often non-standardized with poor quality control or incomplete information. • Data access barriers: Access to data is also a challenge, as AI cannot process low-quality data, resulting in a significant lack of core medical information. In addition, existing medical knowledge graphs may not adequately cover the full range of diseases encountered in PHC institutions.
Talent Barriers	• The integration of new technologies such as artificial intelligence and healthcare has catalyzed a huge demand for composite talents who understand both medical and AI technologies. But the current model of medical personnel is still relatively traditional, and the combination with digital technologies such as AI is not sufficient, resulting in an insufficient supply of corresponding talents. • The application of new technologies requires the support of a large number of professional staff, but the current digital skills training of medical staff in working primary healthcare institutions is insufficient, which is not conducive to the development of AI application in primary healthcare institutions.
Technical Barriers	• Currently, the traditional knowledge base model is an expert system trained from the data of hospitals, and most of them are targeted at specialized difficult or complex diseases. The disease models needed by primary healthcare are for general medicine rather than specialized medicine. The traditional models are difficult to meet the technical needs of the primary healthcare for chronic diseases, infectious diseases and other common diseases, and have great limitations when applied at the primary healthcare. In response to the actual needs of the primary healthcare, numerous innovative products suitable for the primary level should be launched to enhance the accessibility of medical resources.

Source: Frost & Sullivan Analysis

Growth Drivers of AI in Primary Healthcare Institutions

Unequal distribution of healthcare resources promotes AI empowerment at the grassroots level.	• Taking chronic disease management as an example, in recent years, the number of patients with chronic diseases has been increasing year by year, thus putting forward more and higher requirements on the basic public health service work of primary healthcare organizations. In the future, AI will become the grasping hand of chronic disease management at the grassroots level, in order to alleviate the current shortage of high-quality medical resources and uneven distribution in China, so that high-quality medical resources will flow to the grassroots level.
Advances in technology drive further AI applications in primary healthcare institutions.	• Currently, there are problems such as poor quality of clinical data and loss of a large number of high-quality data resources in primary healthcare institutions. Through AI-enabled dynamic data mining, correlation, inference and fusion, as well as the construction of unified terminology and coding standards, it is possible to improve the existing pattern of fragmented data management, achieve the timeliness and completeness of the full-dimensional data, and form a standardized, high-efficiency, and highly-intelligent quality control platform.
Favorable policies drive AI applying in healthcare and primary healthcare institutions.	• In December 2023, the NHC issued the "Guiding Opinions on Comprehensively Promoting the Construction of Closely Tailored County Medical and Healthcare Communities（《关于全面推进紧密型县域医疗卫生共同体建设的指导意见》)", which called for the unification of information systems within county medical communities and the promotion of the application of artificial intelligence-assisted diagnostic technology within county medical communities. It extends telemedicine to the countryside and strengthens data interoperability, sharing and business synergy.

Source: Frost & Sullivan Analysis

Overview of Clinical Decision Supporting System (CDSS)

There is a pressing need for intelligent technology in the healthcare information system in China. Clinical decision supporting system, a promising solution, enables doctors to more accurately and efficiently diagnose diseases. The scope of functions provided by clinical decision supporting system is vast, including diagnostics, inquiry assistance, treatment recommendation, disease management, prescription, and much more.

Definitions and Functions of Clinical Decision Supporting System

- AI clinical decision supporting system refers to a health information technology that provides patient-specific, evidence-based advice at the point of care, to enhance health and health care.

Major Functions of AI Clinical Decision Supporting System

Diagnosis Assistance	Medical Knowledge Query	Patient Counselling	Treatment Recommendation
Provide the most relevant disease based on patients' symptoms and examination results	Provide medical knowledge by key word searching	Guide physicians to inquire specific patient information in detail	Recommend reasonable treatment given patients' conditions

Core Sections of Clinical Decision Supporting System

Medical Knowledge Base

Data Source	Entity Recognition	Relation Detection
• Imaging data • Semantic data • Others	• Entity definition • Data labelling	• Relationship specification • ER modelling

Condition Comprehension

Sequential Decisions

- Patient counselling
- Patient communication and interaction
- Decision optimisation

Diagnosis

Reasoning Based on Knowledge Base	Reasoning Based on Medical Record Retrieval
Knowledge extracted from knowledge can be reference for making decision	Past experience extracted from existing medical records is referred to make decision

Notes: ER=entity relationship

Source: Frost & Sullivan Analysis

Classification of Clinical Decision Supporting System (CDSS)

- Clinical decision supporting systems (CDSS) can be classified into knowledge-based and non-knowledge-based tool by involved technology and general version and specialized version by real-world application. All types of AI clinical decision supporting systems utilize AI techniques including, semantics extraction, machine learning, deep learning, etc., and other state-of-art technologies such as cloud computing, big data, and Internet of things (IoT).

Classification of Clinical Decision Supporting Systems (CDSS)

By Technology

Knowledge-based AI-assisted Diagnostics

Rules are created, with the system retrieving data to evaluate the rule, and producing an action or output. Rules can be made using literature-based, practice-based, or patient-directed evidence.

Non-knowledge-based AI-assisted Diagnostics

The decision leverages artificial intelligence (AI), machine learning (ML), or statistical pattern recognition, rather than being programmed to follow expert medical knowledge.

By Application

General Practice Assistance

- **Users:** It aims to help physicians in primary health facilities to combine their knowledge with information or suggestions provided by rapid patient triage of patients.
- **Usage:** It receives training on whole disease scope and deals with a wide range of disease areas. Hence, it provides diagnosis advice based on analysis of multiple disease. The general versions aid clinicians of primary care in memory-based tasks (e.g. prescribing, screening), as well as judgment-based tasks, such as diagnosis.
- **Market expansion ability**: It can soon be expanded to more markets and achieve larger geographic coverage once pilot studies have been proved successful.

Specialized Practice Assistance

- **Users:** It is mainly tailored to the needs of large comprehensive hospitals and seamlessly embedded in doctors‘ workflows to improve the clinical efficiency.
- **Usage:** Aiming at the current challenges faced by the doctors in the diagnosis and treatment of specialized diseases, the CDSS for specialized diseases has the function of quality control of single diseases, effectively preventing omission and improving efficiency, and it cooperates with Class III hospitals to build an assisted decision-making model to optimize the clinical decision.
- **Market expansion ability:** The specialized version can achieve market expansion only after re-analysing factors such as the doctors’ habits and clinical pathways of the new market, indicating that more efforts need to be exerted to enlarge market share.

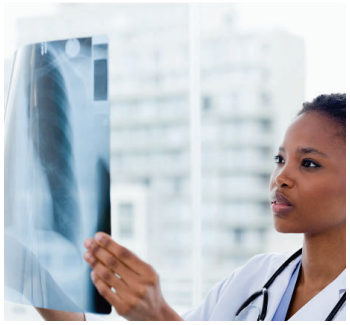
Source: Frost & Sullivan Analysis

Value Analysis of General Clinical Decision Supporting System (CDSS)

- AI-assisted Diagnostics, paving the way for more accurate diagnosis, can aid clinicians with less experience or expertise in diagnosis in primary care to largely improve their diagnosis accuracy rates. By improving diagnosis accuracy and efficiency, AI diagnosis can then mitigate medical resource imbalance and solve problems such as inappropriate onward referrals.

Improve Diagnosis Accuracy

Transform Primary Care Skilled Health Workforce to Be Better Diagnosticians



- Clinicians may produce a distorted range of differential diagnoses through failing to consider the relative prevalence of conditions within a primary care setting. AI approaches draw inferences from, or discover, patterns in data (i.e., treatment guidelines, literature, historical cases, et.) of a wide range disease areas, thereby acting as an expert system to emulate human decision making.

Reduce Incidence of Diagnostic Errors

- AI-assisted diagnostics can help reduce diagnostic errors such as medication errors by developing safeguards for dosing, duplication of therapies, and DDI checking.

Mitigate Medical Resource Imbalance

Facilitate the Implementation of Hierarchical Diagnosis and Two-way Referral Treatment

- Diagnosis in primary care facilities is not only difficult but also not utilised. By improving the diagnosis capacity of physicians in primary care facilities, the implementation of major health care reform policies, such as national grading of diagnosis and two-way referral treatment can be more smooth.

Alleviate Diagnosis Burden in Tertiary Care

- The lack of skilled health professionals in primary care cause the patients' flocking in to tertiary hospitals. AI empowers primary care physicians in diagnosis, thereby mitigating the problem of physician burnout in tertiary care.

Source: Frost & Sullivan Analysis

Favorable Polices of CDSS in China

Policy	Release Date	Issuing Authority	Comments
Guiding Opinions on Promoting and Regulating the Application and Development of Big Data in Health Care 《关于促进和规范健康医疗大数据应用发展的指导意见》	2016/6	State Council	• Promote the application of big data in health care clinical and scientific research: rely on existing resources to build national medical big data resources and build CDSS (Clinical Decision Support System). Make full use of superior resources, optimize the layout of biomedical big data, rely on the National Clinical medical research Center and collaborative research network, systematically strengthen the integration and sharing of clinical and scientific research data resources, improve the efficiency of medical research and application, and promote the development of smart medicine.
Opinions on Promoting the Development of "Internet+ Medical and Health" 《关于促进“互联网+医疗健康”发展的意见》	2018/4	State Council	• Promote "Internet+" artificial intelligence application services: Develop an AI-based clinical diagnosis and treatment decision support system, carry out intelligent medical image recognition, pathological classification and multidisciplinary consultation, and intelligent voice technology application in a variety of medical and health scenarios to improve the efficiency of medical services.
Notice on Issuing Opinions on Strengthening Pharmaceutical Administration in Medical Institutions and Promoting Rational Drug Use 《关于印发加强医疗机构药事管理促进合理用药的 意见的通知》	2020/2	NHC、NHSA、NMPA	• Standardize "Internet + pharmaceutical care" : In the process of carrying out Internet diagnosis and treatment or telemedicine services, pharmacists in physical medical institutions should be the main body, and actively provide online pharmacy consultation, guide patients to rational drug use, drug knowledge education and other "Internet + pharmaceutical care".
Notice on Further Strengthening Drug Safety Management and Improving the Level of Rational Drug Use 《关于进一步加强用药安全管理提升合理用药水平的通知》	2022/7	National Health Commission	• Further strengthen drug safety management, improve the level of rational drug use, and protect medical quality and people's health rights and interests: medical institutions should improve and implement medication safety related systems, improve the awareness and ability of medical care personnel to prevent medication errors, and implement the whole process management of prescription issuance, allocation, drug administration and drug use. Encourage medical institutions to use information means to carry out intelligent review and management of the whole process of clinical drug use.
Notice on the issuance of Clinical Decision Support System Application Management Standards for Medical Institutions (Trial) 《关于印发医疗机构临床决策支持系统应用管理规范（试行）的通知》	2023/7	National Health Commission	• Guide local health administrative departments and relevant medical institutions to promote and strengthen the application management of CDSS: clarify the basic requirements that CDSS should meet and the basic requirements of information technology. Medical institutions should have a relatively complete medical information system foundation, and data should be unified, standardized, complete and accurate. The application management requirements of CDSS in medical institutions are clarified, including organization management, training, monitoring and evaluation, maintenance and update of CDSS knowledge base, etc.

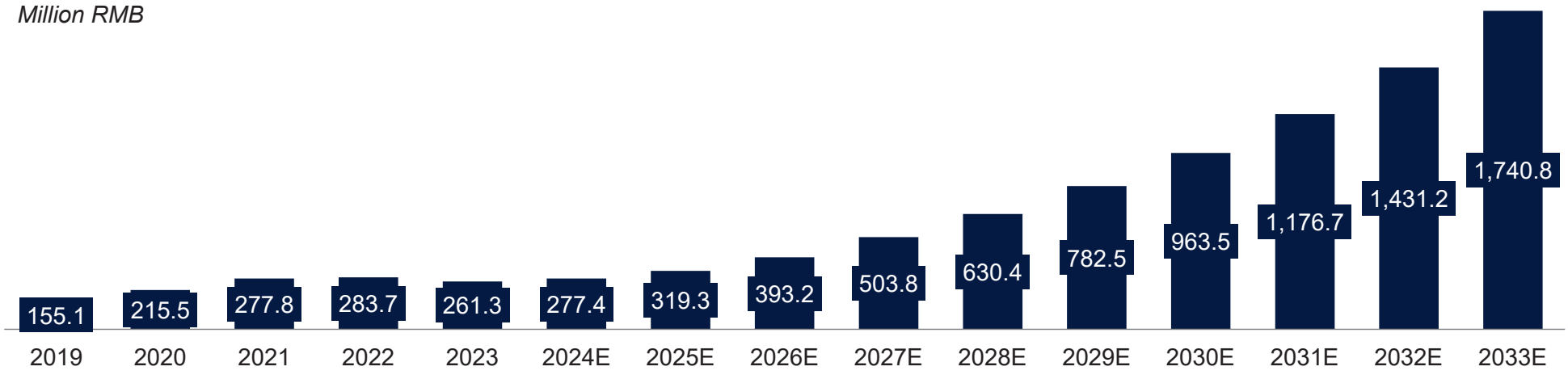
Source: Government Notices, Frost & Sullivan analysis

Market Size of Primary Healthcare Institution CDSS in China, 2019-2033E

- The clinical decision support system include CDSS in hospital and CDSS in primary healthcare institutions. The market size of CDSS in primary healthcare institutions in China was RMB 155.1 million in 2019 and RMB 261.3 million in 2023, with the CAGR of 13.9% during this period. In the future, the CDSS in primary healthcare institutions in China is expected to reach to RMB 1,740.8 million in 2033, representing a CAGR of 20.9% from 2023 to 2033.

Market Size of Primary Healthcare Institution CDSS in China, 2019-2033E

Period	CAGR
2019-2023	13.9%
2023-2033E	20.9%



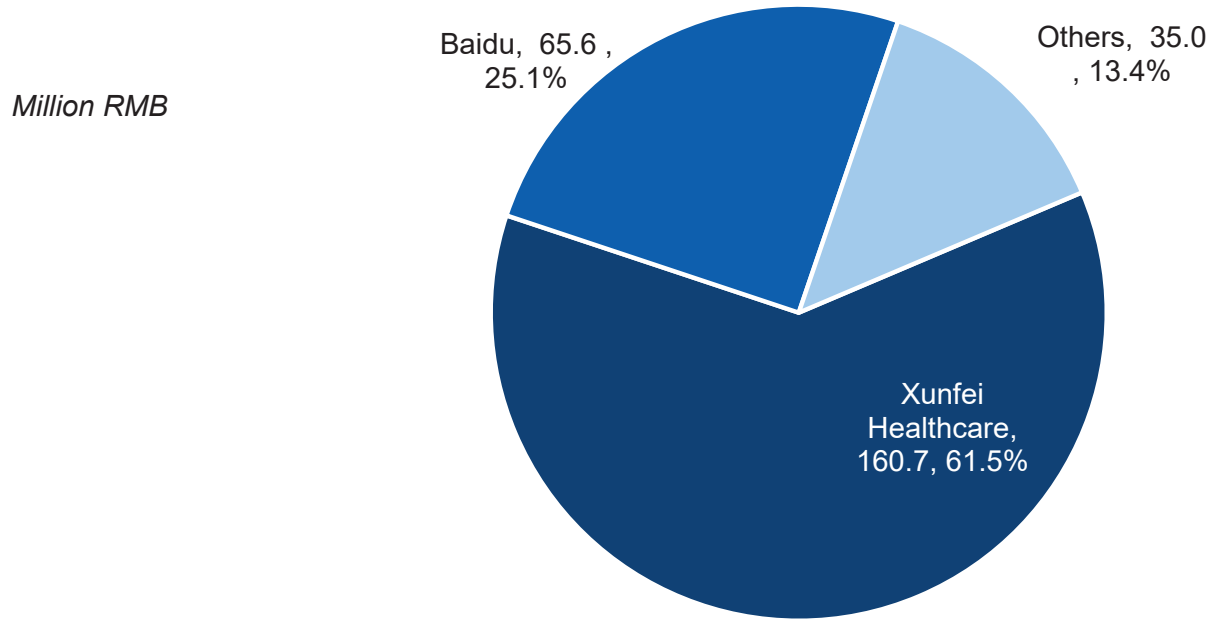
Notes: The forecast part of data only includes the sales of existing types of CDSS, and does not predict the replacement of traditional hospital information systems by CDSS.

Source: China Health Statistical Yearbook, Public Companies' Filings, Literature Review, Frost & Sullivan Analysis

Breakdown of China Primary Healthcare Institution CDSS Market by Providers, 2023

- In 2023, Xunfei Healthcare ranks first in China Primary Healthcare Institutions CDSS market with the share of 61.5%, followed by Baidu at 25.1% of market share. Xunfei Healthcare and Baidu account for 86.6% of China Primary Healthcare Institutions CDSS market and the rest of players capture the share of 13.4% in 2023.

Breakdown of China Primary Healthcare Institution CDSS Market by Providers, 2023



Source: Frost & Sullivan Analysis

Growth Drivers and Future Trends of General Practice CDSS

CDSS Promotes the Sinking of Medical Resources and Enhances the Specialization of General Medical Service	• There is a large gap between the medical technology level of primary medical institutions and hospitals, and between cities and villages. Developed regions concentrate most of the national medical resources, while economically backward regions have backward medical equipment and a lack of professionalism among medical staff.In 2020, the National Health Commission and the State Administration of Traditional Chinese Medicine formulated the "Notice on the Issuance of Measures for the Management of Medical Consortiums (for Trial Implementation)", which calls for accelerated promotion of the construction of medical consortiums, and the gradual realization of the management of medical consortiums with a grid-based layout. • CDSS has a rich medical knowledge base, which can help doctors make diagnosis and treatment decisions, provide general consulting services for primary healthcare institutions, and to a certain extent, can narrow the gap between urban and rural medical resources and promote the construction of medical consortia.
In response to the imbalance between supply and demand in primary care, the general practice CDSS will further penetrate primary general practice.	• The majority of our outpatients are elderly people, who often suffer from a variety of chronic diseases, coexisting with multiple illnesses. However, GPs at the grassroots level are unable to adequately meet the medical needs of elderly outpatients due to insufficient numbers, the capacity of medical services to be improved and other limiting reasons. • General practice CDSS can assist general physicians in making clinical decisions based on information such as patients' symptoms, past medical history and examination results, and improve the accuracy of diagnosis of common diseases, as well as avoiding the omission and misdiagnosis of critical illnesses.
The general practice CDSS will empower the field of education and assist GPs in acquiring more specialized knowledge and skills.	• The general training of general practitioners is costly and time-consuming, and the number of qualified general practitioners in China who have received general training for general practitioners is insufficient, and there is a large unmet needs on the supply side of general medical services. • Supported by a massive medical knowledge base, general practice CDSS summarizes the clinical experience of many past diagnoses and treatments of diseases, enabling GPs to obtain disease treatment guidelines more conveniently, and systematically organize the complex guidelines in combination with the needs of GP outpatient clinics, so that GPs can learn quickly in practice, and then assist them in making clinical decisions.
Referral of severe patients is in high demand, and a more scientific management system will be developed for the general practice CDSS	• Due to the difficulty in diagnosing difficult and complicated diseases or the need for specialized treatment after diagnosis, the aggravation of the patient's condition, or the limitation of medicines in the community, etc., general medical institutions need to refer patients to higher-level medical institutions. • Based on the patient's clinical data and needs, the CDSS can assist general practitioners in making referral decisions and determining the basis for referral, such as whether to refer the patient and the direction of referral. Secondly, the CDSS can provide information transfer, referral coordination, and prompt patients to follow up after referral. Finally, GP CDSS can manage the quality of referrals, including analyzing the reasonableness of referrals and performing statistics on referral data.

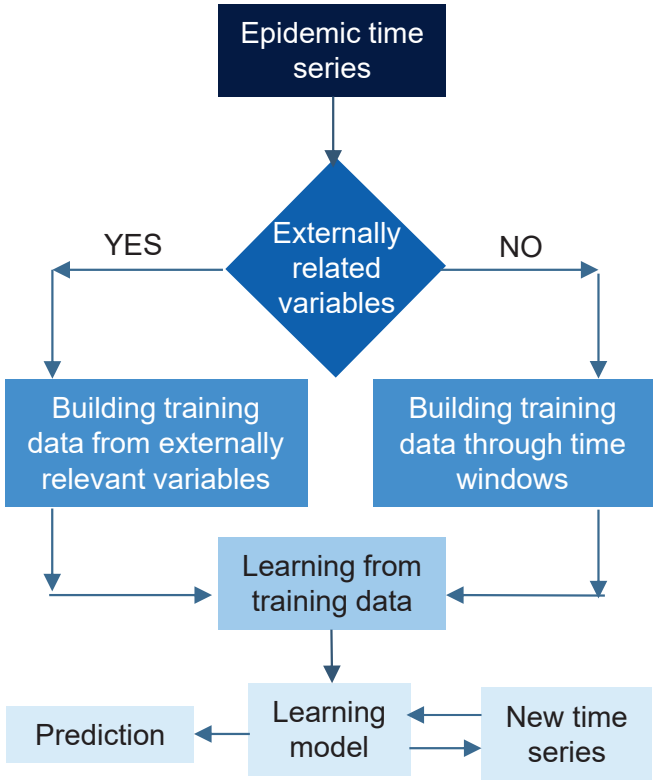
Source: Frost & Sullivan Analysis

Overview of AI Infectious Diseases Prevention and Control

Artificial intelligence is playing a crucial role in the infectious disease prevention and control (IPC). Advancement of Artificial Intelligence can help the scientists in predicting the infectious diseases to contain the spread of pandemic, understanding the behaviour of microorganisms and also help in faster drug discovery to contain the disease.

Definition and Framework

Definition: AI IPC is an epidemic forecast system of infectious prevention and control in terms of artificial intelligence.



AI methods to track health-behaviours during infectious disease epidemics:

Types	Methods	Functions
Supervised method	Support Vector Machine (SVM), Decision Tree, Random Forest, Naive Bayes (NB), Artificial Neural Network (ANN), Bootstrap Aggregating, AdaBoost	The primary function of these methods is to create prediction outcomes to warn authorities and public in advance on potential infectious disease epidemics, thus suggesting immediate prevention and control strategies.
	Principal Component Analysis (PCA)	This method aims to reduce data dimensions to enable researchers easily uncover key factors causing infectious disease dynamics
	K-Means	This method clusters patients for abnormality detections
Unsupervised method	Latent Dirichlet Allocation (LDA)	This method enables data extraction from medical contextual records
	Deep Learning Architectures	This method facilitates prediction and classification, social network filtering and applications of bioinformatics in infectious disease analytics
	Structural Equation Model Trees	This method allows estimation of complex cause-effect relationship models with latent variables

Source: Frost & Sullivan Analysis

Development Status of AI Infectious Diseases Prevention and Control

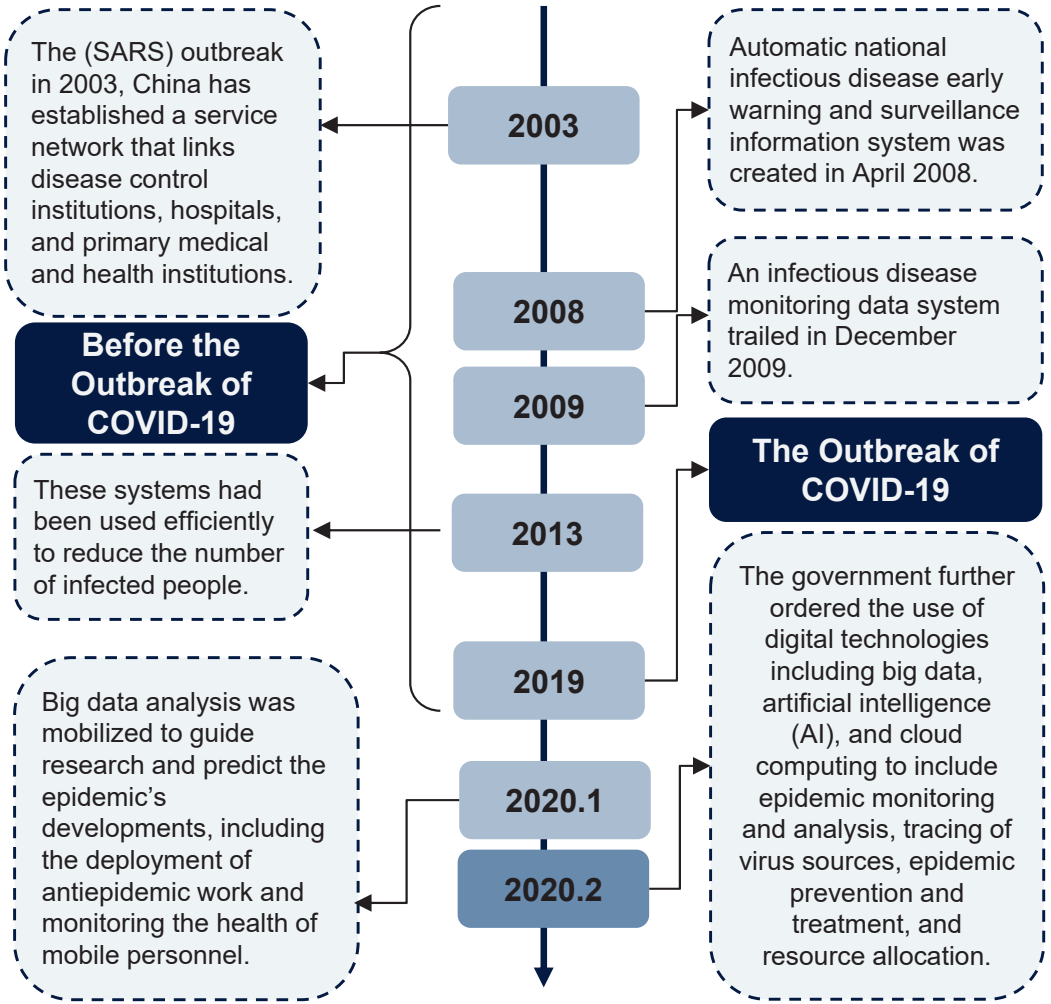
- From the perspective of industry participants and the current situation of the market, the public health field is still in the early stage of artificial intelligence and is still a blue ocean market, with an accelerated development trend catalyzed by COVID-19.

Application of artificial intelligence in prevention and control of infectious diseases in China

AI-aided diagnosis software
The AI algorithm can quickly form the initial diagnosis report by evaluating the degree of pulmonary infection in patients to develop an accurate diagnosis and treatment plan in COID-19. The algorithm can also be prioritized according to the degree of pulmonary abnormality to guide the intelligent diagnosis

AI algorithms build epidemiological survey models
The AI accurately follows the flow of traces to simulate the epidemic-transmission process. Based on the data collected on virus characteristics, propagation speed, lesion development, and symptoms, several AI research teams in China constructed models, such as the epidemic situation map, real-time dynamics, and data reports.

AI algorithms assist in predicting virus hosts
South China Agricultural University and the China Centre for Animal Health and Epidemiology examined 4,800 samples with AI-empowered mathematical models. The effort pushed the implementation of emergency legislation to prohibit trade and indiscriminate consumption of wildlife. The infectious transmission is contained by removing the transmission route.



Source: Frost & Sullivan Analysis

Typical Applications/Products of AI Infectious Disease Management in China

Company	Xunfei Healthcare	Yidu Cloud	Neusoft	Winning Health	Pingan Cloud
Product	AI Outbound Call Robot & AI Disease Monitoring Platform	YiduCore	COVID-19 Prevention and Control Information System	Intelligent Regional Healthcare	Epidemic Prevention and Control Platform
Launch Year	2018	2014	2020	2021	2013
Description	AI Disease Monitoring Platform: a platform empowered by data from sources such as its AI Outbound Call Robot and its CDSS platform to create regional monitoring services for infectious diseases, chronic diseases, and mental illness	YiduCore builds a digital and intelligent mode of public health dynamic supervision, which establish an "urban immunization platform".	AI decision support platform for epidemic prevention and control.	The product facilitates the synergized governance of public health events by providing information sharing, real-time monitoring and decision-making support.	Integrate historical monitoring data, climate, public opinion and other factors, and adopt AI technology to establish an incidence trend prediction model.
Function	• AI Outbound Call Robot: help control epidemics, facilitate post-treatment patient follow-up and so on. • AI Disease Monitoring Platform: utilize healthcare data to realize regional management of certain diseases	• Based on this infectious disease monitoring and early warning platform, close contacts tracking, multi-scene monitoring and prediction, and multi-channel joint prevention can be carried out. • The simulation system help government simulates the epidemic trend under the influence of different policies and measures.	• Provides dynamic statistical analysis of fever outpatient clinics and visualization of regional epidemic information. • Provides case tracking, monitoring and analysis, enabling the grid management of epidemic.	• Owns built-in disease monitoring service engine to support seamless integration with heterogeneous business systems. • Achieves automatic and intelligent notification of trend changes of infectious disease.	• Monitors the incidence of 39 regional infectious diseases and major infectious diseases in sentinel hospitals to provide early warning, recommend precise prevention and control measures. • Automatically generate periodic reports of diseases.
Implementation	AI Outbound Call Robot cumulative service times have reached for 400 million as of June, 2021.	The platform has covered more than 8 cities where the COVID-19 epidemic had occurred.	The system has been installed in more than 300 hospitals in China during the COVID-19 epidemic.	The intelligent healthcare together with other healthcare IT services have been applied in more than 300 Class III hospitals.	The platform has cooperated with 11 hospitals (e.g. Huashan Hospital, Fudan University).

Source: Frost & Sullivan Analysis

Growth Drivers and Future Trends of AI in Infectious Disease Prevention and Control

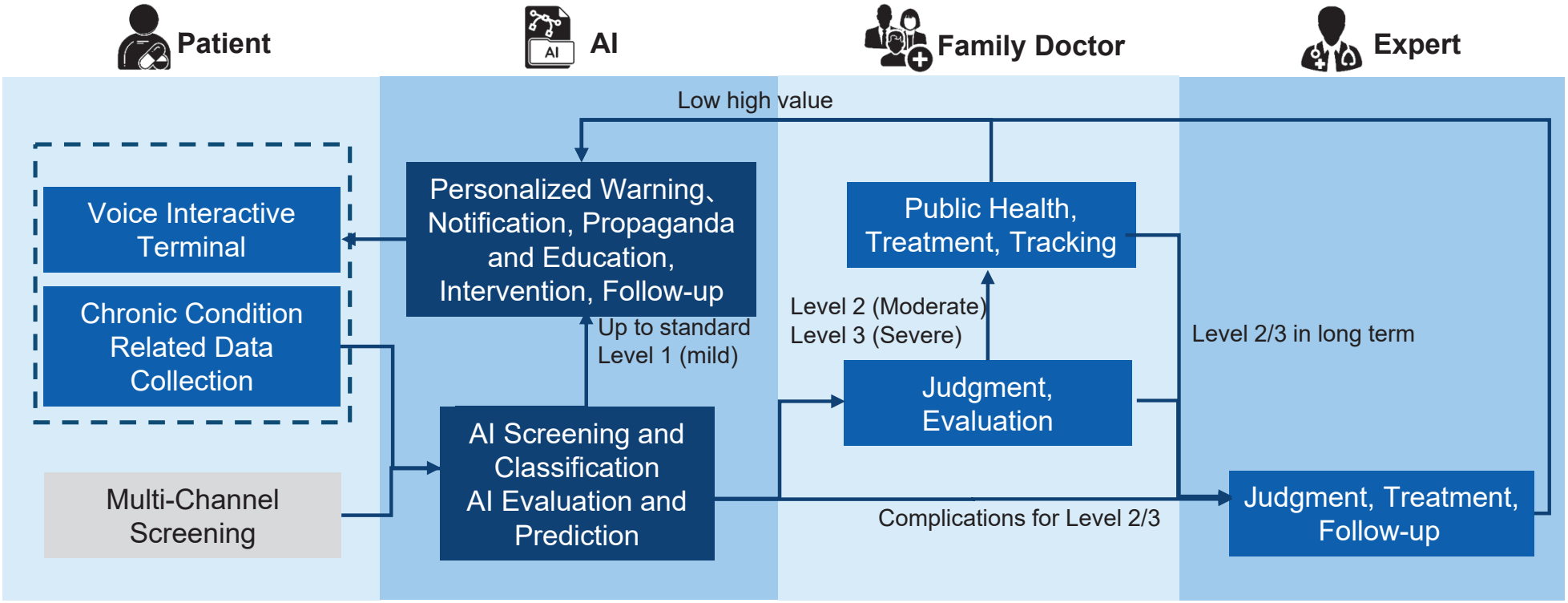
Upper-level policies drive the application of digital technology in infectious disease prevention and control, and the future of AI in infectious disease management will present more possibilities.	• In 2021, the Ministry of Science and Technology (MOST) issued a national key research and development program on "Research on Pathogenesis and Epidemic Prevention Technology System", emphasizing the establishment of an integrated system for the prevention and control of major infectious diseases. Research units are encouraged to integrate data from different sources, and through high-throughput control technology, realize the standardization and consistency of digitized information to meet the needs of data convergence management and research utilization. • In the future, AI will have greater application value in dimensions such as predicting the probability of infectious disease outbreaks, transmission paths and traceability exclusion, development posture prediction, and contactless medical services.
The legal and ethical issues in the application of AI in the prevention and control of infectious diseases need to be resolved urgently, and the relevant legal responsibilities need to be clarified.	• AI can be used in infectious disease prevention and control to improve the speed and accuracy of disease diagnosis and screening; and to support diverse public health interventions. • However, the current development of AI lacks laws and regulations that are forward-looking, operational, and guiding. Future issues such as personal information protection and data sharing urgently need to be clarified by legislation.

Source: Frost & Sullivan Analysis

Overview of AI Chronic Disease Management

- AI can be very helpful in providing an integrated care approach required to manage chronic conditions efficiently. Applications of AI can not only be extremely helpful in every stage of CDM from diagnosing, treating to managing disease, and it can even prevent conditions to become chronic.
- The implementation of scientific and effective chronic disease classification and hierarchical management is conducive to the sinking of high-quality medical resources, realizing the rational use of medical resources, and effectively alleviating the current situation of difficult and expensive medical treatment. Stratified management of patients can assist in patient follow-up and patient education, and improve the health management level of patients with chronic diseases throughout the cycle.
- Separated treatment for acute and chronic disease can improve the service chain of treatment, rehabilitation and long-term care, and provide patients with scientific, appropriate and continuous diagnosis and treatment services.

Process of AI Chronic Disease Management



Source: Frost & Sullivan Analysis

Overview of Chronic Diseases

Definition

Chronic diseases, are defined broadly as conditions that last 1 year or more and require ongoing medical attention or limit activities of daily living or both. Numerous people die from chronic diseases annually and huge economic burden in healthcare industry is created.

Risk factors

- Excessive Alcohol Use
- Poor Nutrition
- Lack Of Physical Activity
- Tobacco Use

...

Characteristics

- Common disease
- Complex causes
- Hard to cure
- Cause heavy economic burdens
- Occult disease

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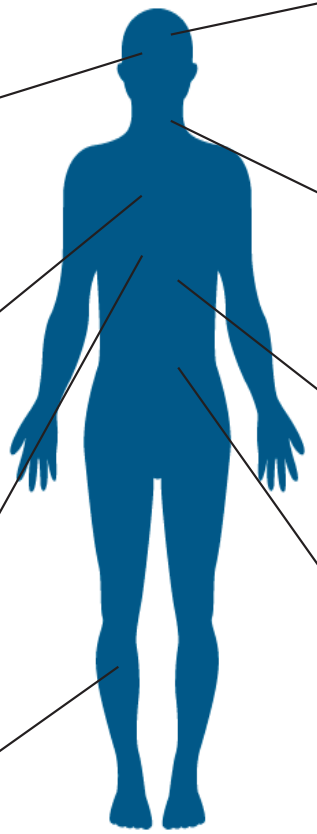
Typical Chronic Diseases

In China, there is currently no definition, classification, and outpatient service guidance named specifically for chronic diseases on the national level. However, each province has settled certain standards.



Neurological diseases
Cervical spondylosis, stroke, Parkinson's disease, Alzheimer's disease

CVD diseases
coronary heart disease, hypertension, chronic heart failure, arrhythmia, coronary atherosclerotic heart disease

Gastroenterological diseases
peptic ulcer, ulcerative colitis, irritable bowel syndrome, hepatic steatosis, chronic hepatitis, alcoholic liver disease

Bones and muscles
chronic pain, arthritis, movement disorders, osteoporosis

Psychiatric diseases
sleep disorder, depression, anxiety disorder, autism spectrum disorder

Respiratory diseases
chronic obstructive pulmonary disease, bronchial asthma, pulmonary hypertension, pulmonary fibrosis

Metabolic diseases
gout, diabetes, obesity, hyperlipidemia, Thyroid disease

Renal diseases
chronic kidney disease, nephrotic syndrome, chronic nephritis, IgA nephropathy

Pediatric diseases
stunting, malnutrition, obesity, anemia

Source: CDC, Frost & Sullivan Analysis

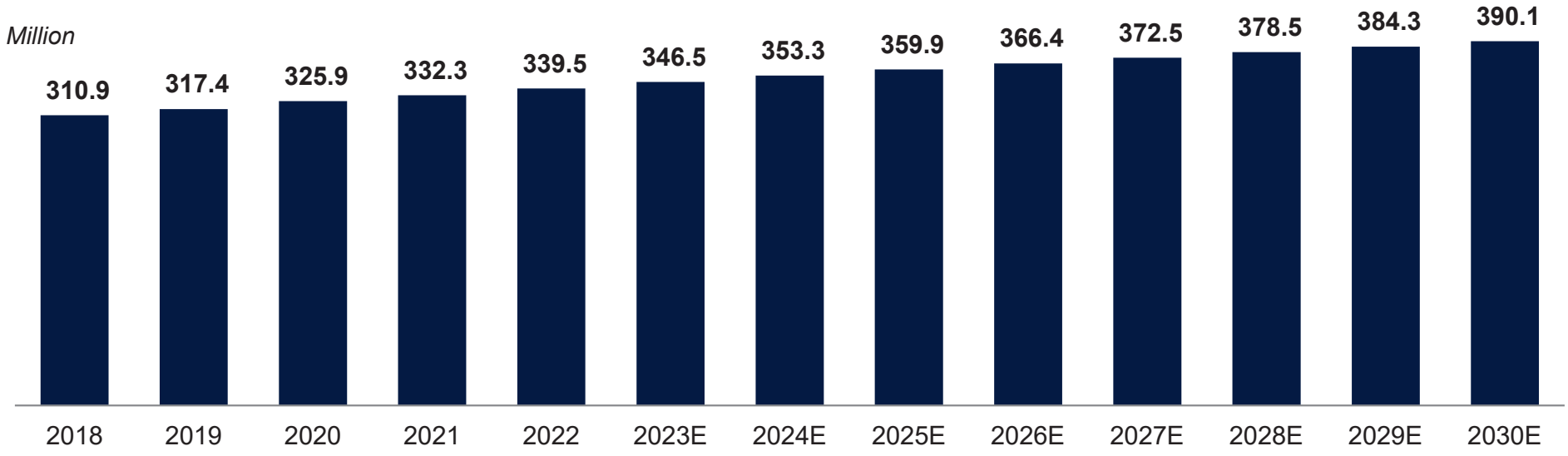
Prevalence of Typical Chronic Disease in China, 2018-2030E

Hypertension

- The prevalence of hypertension in China has been rising continuously during the past two decades. According to 《中国心血管健康与疾病报告2022》, CCDRFS conducted a cross-nation survey of hypertension in 2018, showing a prevalence rate of 27.5% in adults. Another epidemiology study published in 2020 indicates the prevalence of hypertension grows with aging. 5% of adults younger than 34 years old and 15% of people with an age ranging from 35 to 44 suffer from hypertension, whereas about 37% of people aging from 45 to 65 and over 55% of the elderly above 65 years old have this type of chronic disease. Consequently, major causes of morbidity and mortality in China have shifted from primarily infectious diseases to chronic, particularly cardiovascular diseases.

Prevalence of Hypertension in China, 2018-2030E

Period	CAGR
2018-2022	2.2%
2022-2026E	1.9%
2026E-2030E	1.6%



Source: NCCD, CDC, Frost & Sullivan Analysis

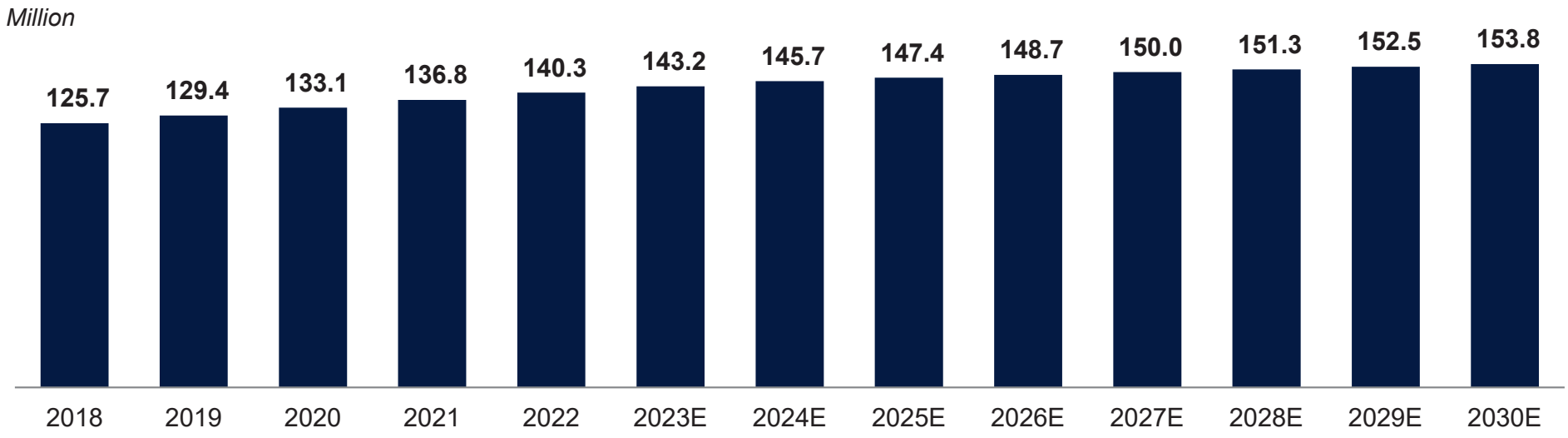
Prevalence of Typical Chronic Disease in China, 2018-2030E

Diabetes

- Diabetes is an important health problem in China and over the past three decades, the prevalence of diabetes in China has sharply increased. According to the recent statistics, the possibility of adults having diabetes increases with ages. People from 20-24 years old have the lowest chance at 1.4%, while mid-aged adults' chances to get diabetes increase exponentially with increasing age. Approximately 20% of people over 65 years old have diabetes. With an aging population, China is expected to have continuously growing diabetes patients.

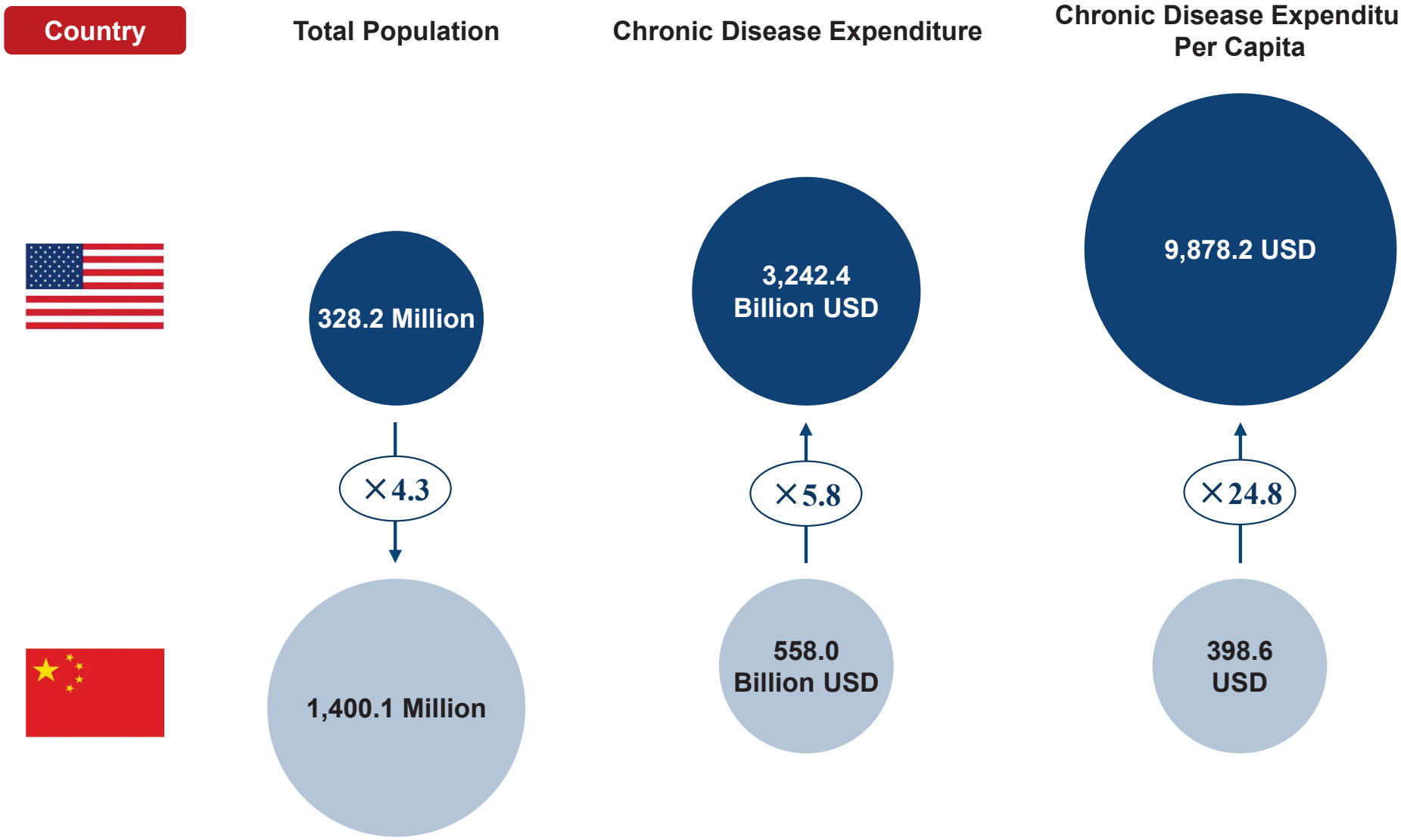
Prevalence of Diabetes in China, 2018-2030E

Period	CAGR
2018-2022	2.8%
2022-2026E	1.5%
2026E-2030E	0.9%



Source: NCCD, CDC, Frost & Sullivan Analysis

Comparison of Chronic Disease Related Healthcare Expenditure in China VS. United States



Source: Frost & Sullivan Analysis

Favorable Policies of Chronic Disease Management (1/2)

Release Date	Issuing Authority	Policies	Comments
Feb, 2017	General Office of the State Council	*Medium-to-Long Term Plan (2017-2025) for the Prevention and Treatment of Chronic Diseases in China*《中国防治慢性病中长期规划（2017-2025年）》	• Strengthen the prevention and treatment of chronic diseases, reduce the burden caused by diseases and increase the healthy life expectancy of residents. By 2020, the environment for prevention and control of chronic diseases will be significantly improved, and the premature mortality caused by chronic diseases will decrease significantly. By 2025, the risk factors for chronic diseases will be effectively controlled.
Jun, 2017	General Office of the State Council	*Guidance on Deepening the Reform of Basic Medical Insurance Payment Methods*《国务院办公厅关于进一步深化基本医疗保险支付方式改革的指导意见》	• Implement multiple and complex medical insurance payment methods. Long-term chronic disease patients in hospitals can be paid per bed per day. Encourage designated retail pharmacies to supply of drugs for chronic disease patients.
Sept, 2018	National Health Commission, National Administration of Traditional Chinese Medicine	*Guidance on Regulating the Management of Family Doctor Contract Services*《关于规范家庭医生签约服务管理的指导意见》	• Build an online interactive platform for family doctors and contracted residents to provide chronic disease consultation and follow-up services. On the premise of ensuring the safety of medication, family doctors can prescribe medicine for patients with chronic diseases who have stable conditions and good compliance.
Jul, 2019	National Health Commission	*Healthy China Action (2019-2030)*《"十三五"卫生与健康规划》	• Focusing on disease prevention and health promotion, the governments will take a series of measures, including health knowledge popularization, tobacco control, mental health promotion, cardiovascular and cerebrovascular disease prevention and cancer prevention, to reduce the illness rates of residents.
Sept, 2019	National Development and Reform Commission	*Action Plan for Promoting High Quality Development of Health Industry (2019-2022)*《促进健康产业高质量发展行动纲要（2019-2022）》	• Increase health examinations, health risk assessments, health consultations and health intervention services for chronic disease patients. Improve the diagnosis and treatment ability of traditional Chinese medicine. Promote the integration of sports and medical services to achieve the goals of chronic disease preservation, rehabilitation, and health promotion.

Source: Government Websites, Frost & Sullivan Analysis

Favorable Policies of Chronic Disease Management (2/2)

Release Date	Issuing Authority	Policies	Comments
Dec, 2020	National Health Commission,etc.	*Circular on Further Promoting the "Five-One" Service Action of "Internet+ Medicine and Healthcare"*《关于深入推进“互联网+医疗健康”“五个一”服务行动的通知》	• Encourage localities to utilize intelligent Internet of Things terminal equipment to carry out monitoring, tracking and management of data on the characteristic indicators of patients with chronic diseases and high-risk groups, and to sink health management into community service sites in conjunction with family doctor contracting services.
Mar, 2021	National Health Commission	*Notice on Improving the Current Management of Prescriptions for Long-term Use of Drugs for Chronic Diseases*《关于做好当前慢性病长期用药处方管理工作的通知》	• Strengthening the management of daily medical services and improving the long-term prescription management policy for patients with chronic diseases. • Measures are taken to meet the medical service needs of patients with chronic diseases requiring long-term medication, hemodialysis and other special treatments. • Strengthening medication education for patients using long-term prescriptions and improving their ability to manage their own medication.
Apr, 2021	National Development and Reform Commission, etc.	*National Basic Public Service Standards (2021)*《国家基本公共服务标准》（2021年版）	• Implementing a system of long-term prescriptions for chronic diseases. • Gradually expanding the scope of medical insurance payments for "Internet+" medical services for common and chronic diseases.
May, 2022	State Council	*The 14th Five-Year National Health Plan*《“十四五”国民健康规划》	• Improve the comprehensive prevention and treatment of chronic diseases, gradually establish and improve the chronic disease health management system and management system, and promote the integrated development of prevention, treatment, recreation and management. • Focusing on the management of chronic diseases, pension services and other needs, it has focused on the development of intelligent rehabilitation aids, scientific fitness and other new health products.
Mar, 2023	National Health Commission	*Highlights of Healthy China Action 2023*《健康中国行动2023年工作要点》	• Strengthening the health management of patients with hypertension, diabetes and other chronic diseases, promoting the integration of medical care and prevention, and improving the quality of services" has been incorporated into the key work of the National Health Commission, which has taken the lead in this area and is making solid progress.

Source: Government Websites, Frost & Sullivan Analysis

Typical Applications/Products of Chronic Disease Management in China

Platform Type	Auxiliary Platforms of Medical Institution			One-stop Ecological Platform
Service Provider	科大讯飞 IFLYTEK | 讯飞医疗	JIANHAI 健海科技	医联	智云
Company Type	Healthcare Technology	Healthcare Technology	Healthcare Technology	Healthcare Technology
Product	• AI Outbound Call Robot • iFLYDOC • Hardware products	• Jiji brain • Center for Disease Management	• Chronic disease management platform	• SaaS for Hospitals • ClouDr. e-Clinic • SaaS for Pharmacies
Launch Year	2018	2015	2014	2014
Description	• AI Outbound Call Robot: An intelligent voice calling system based on AI speech recognition technology. • iFLYDOC: An AI hypertension management system; • Hardware products such as blood pressure meter and blood glucose meter	• Focus on "AI Follow-up" • Jiji brain: AI engine, fully enabling post-hospital patient management services • Center for Disease Management: The third-party disease management service	• Provide doctors: AI medical assistance, intelligent prescription review system, intelligent follow-up data, etc. • Provide: AI customer service, smart wearables, medication guidance and cloud pharmacy, etc.	• ClouDr APP: a health management software tailored to those living with chronic diseases • Dr. ClouDr: APP brings together authoritative internists and real-time interaction with patients with chronic diseases. • SaaS system for pharmacies: platform customized for pharmacies, which, with the guidance of physicians from ClouDr e-Clinic, can supply patients with prescription drugs.
Implementation	• AI Outbound Call Robot: has been adopted by more than 10 hospitals • iFLYDOC: The pilot studies are being carried out in more than 2 hospitals.	• Covering hospitals 1000+ • Online doctors 20,000 • Online nurses:100,000 • Cumulative service patients 200,000,000 passes	• Cover 12 chronic diseases areas • Has 800,000+ real-name registered doctors and 50,000 contracted doctors	• SaaS serving 30 provinces • Collaborative pharmacies 120,000 • Thousands collaborative hospitals

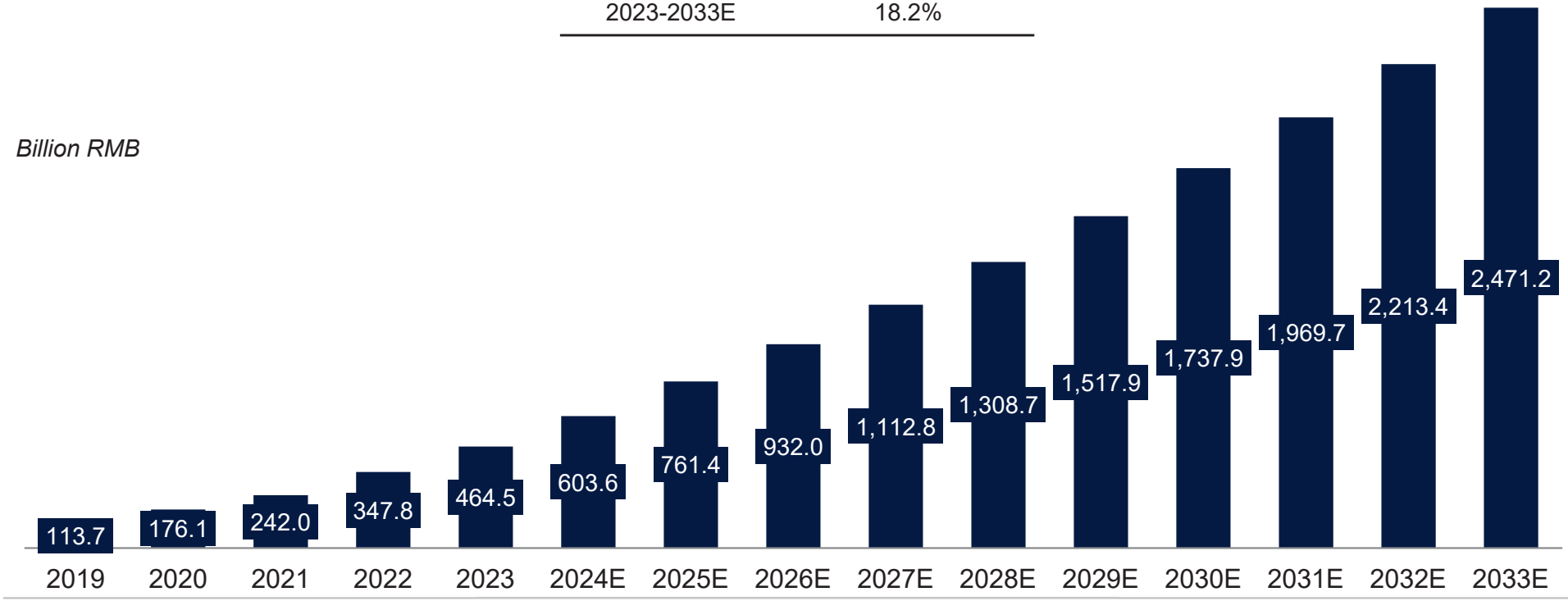
Source: Frost & Sullivan Analysis

Market Size of Digital Chronic Condition Management in China, 2019-2033E

- In 2023, the market size of digital chronic disease management in China is RMB 464.5 billion, compared to RMB 113.7 billion in 2019, and a CAGR of 42.2% is presented over this period. The total market of digital chronic disease management in China is expected to further grow to RMB 2,471.2 billion in 2033 with a CAGR of 18.2% from 2023 to 2033.

Market Size of Digital Chronic Condition Management in China, 2019-2033E

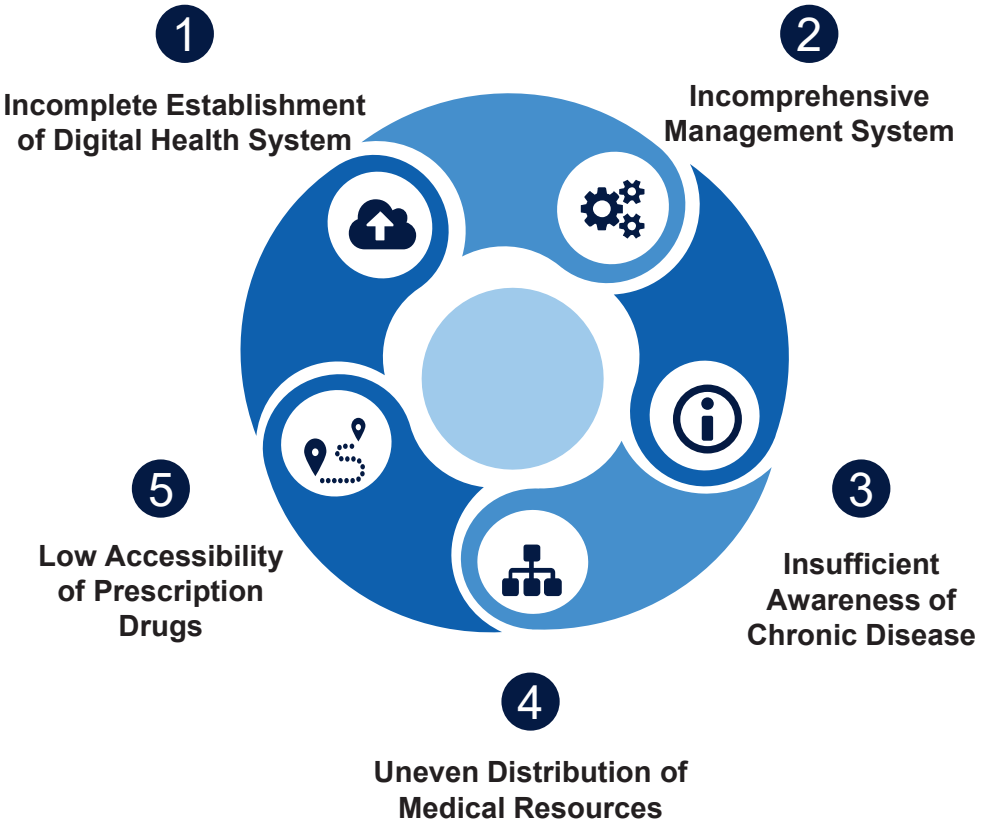
Period	CAGR
2019-2023	42.2%
2023-2033E	18.2%



Source: China Health Statistical Yearbook, Public Companies' Filings, Frost & Sullivan Analysis

Pain Point Analysis of Current Prevention and Treatment of Chronic Disease in China

Pain Point Analysis



1 **The application of digital health system is in progress but still incomplete.** The digitalization level of the current data collection and related management for chronic disease treatment remain far behind developed countries. Islands of redundant and inconsistent information are therefore formed. In addition, post-discharge care/management should be conducted to trace patients' condition, medication, etc. to prevent readmission.

2 **Inconsistency and disjunction may exist in the current management of the prevention and treatment of chronic diseases.** Even though policies and programs had been implemented on national level to improve the current condition of chronic disease in China. The management of execution on provincial level remains not effective enough, which can ensures the implementation of each aspect of the policies or programs.

3 **The awareness of preventing and treating chronic disease in China is insufficient.** The knowledge level with respect to chronic disease in China is currently far behind developed countries, causing the difficulty in putting prevention measures into practice. Low awareness also leads to insufficient patient compliance during the treatment stage.

4 **Medical resources in China is concentrated in municipal hospitals while county hospitals target chronic diseases.** Part of the county hospitals (Grade I, II) still lack the ability of chronic disease treatment and prevention. This forces patients to be treated in municipal hospitals, resulting in an overall low efficiency in disease treatment.

5 **Low accessibility of prescription drugs as purchasing channels are primarily concentrated within hospitals.** Chronic condition patients often have to repeatedly experience the unpleasant and inefficient offline outpatient visit to renew prescription and receive their regular long-term medications. Recent policy guidelines in China are promoting prescriptions to flow out-of-hospitals which are helpful in making prescription drugs more accessible in retail pharmacies especially for those commonly prescribed for chronic condition management purposes.

Source: Frost & Sullivan Analysis

Value Analysis of AI Chronic Disease Management

Benefits	Comments
Creates a Positive Feedback Loop	• Due to chronic disease management system can provide patients with timely and personalized healthcare services, it can stimulate patients to actively update their clinical feedback to the physicians, and help the physicians better understand the patients' condition and make correct clinical decisions (e.g., adjusting the medication), which in turn, also brings high-quality treatment and better experience to the patients.
Controlled Medical Expense	• The preventive nature of chronic disease management, particularly with AI technological support, can help individuals avoid a tremendous amount medical and health expenses. According to WHO, every RMB invested in preventive healthcare focusing on health check-ups can save individuals and society 8.6 RMB in medical expenses or 100 RMB in rescue costs.
Improve Access to Medical Services	• For chronic disease patients, physicians can perform post-diagnosis follow-up for patients with the assistance of AI outbound call system. The post-diagnosis management system has automatic Q&A function which fulfills the medical inquiry demand of patients. • Additionally, the follow-up system can automatically generate EMR for patients to monitor and record their conditions and provide medication guidance, which make it possible for patients to access to the medical service out of hospital.
Simplify User Operations	• AI helps simplify user operations with deep learning and NLP technologies, becoming more user-friendly. For example, when patients want to know some typical medical knowledge, they only need to ask questions to the Chatbots embedded in the websites or Apps, instead of searching the ambiguous keywords in person to find the relevant content. Chatbots can understand the meaning and automatically search and screen the useful information for the users. Such function simplifies the operation steps which is originally complex and difficult for the elders. AI promotes the upgrade of medical service products and improves the user experience.

Source: Frost & Sullivan Analysis

Growth Drivers and Future Trends of AI Chronic Disease Management

Individual chronic disease care is of low quality, and AI will advance its refinement, homogenization and systematic development.	• The number of deaths due to chronic diseases in China is huge every year, and the number of diseases continues to rise. However, the traditional chronic disease management model still exists problems such as limited scope of population monitoring, fewer types of risk factors to be monitored, low degree of personalization in the formulation of monitoring programs, and weakened effect of health interventions due to lack of individual self-management. • AI can automatically complete the management of most chronic disease by the system, effectively make up for the current shortage of primary general practitioners, promote the implementation of hierarchical diagnosis and treatment of chronic disease management, enhance the efficiency of medical resource utilization, and truly realize the refinement, homogenization and systematization of chronic disease management.
Chronic disease management data is huge, and AI will help characterize chronic disease groups and predict chronic disease development with new models.	• The accuracy, continuity and completeness of traditional chronic disease prevention and control monitoring data are poor, and the volume of data is so large that it is difficult to be completed by manpower. • AI brings a new model for chronic disease management, helping to characterize chronic disease groups and predict chronic disease development. In turn, it can promote the risk prevention and early warning effect of chronic disease complications and the improvement of chronic disease prevention and treatment. • Strengthening data governance not only helps to improve the government's social governance capacity, but also helps to improve the level of public services.
The path of artificial intelligence technology exploration requires the development of more high-performance and flexible machine learning algorithms.	• Currently, there is a limited variety of variables and a single modeling algorithm in the chronic disease risk prediction model. It should also be noted in future chronic disease risk prediction studies: a) Incorporating health-related factors and biomarkers such as diet and sleep into the model; b) Reasonable selection of modeling methods to improve the practical value of the model; c) Use data from large cohort studies conducted in different regions and populations to validate the models. d) This will facilitate the translation and promotion of chronic disease risk prediction models and help realize early detection and early intervention of chronic diseases.

Source: Frost & Sullivan Analysis

Table of Content

Overview of Intelligent Health Insurance Solutions

Current Issues

Insufficient Qualified Staff

Most health insurance auditors do not have a medical background and have no clinical experience, and health insurance audits are often a formality.

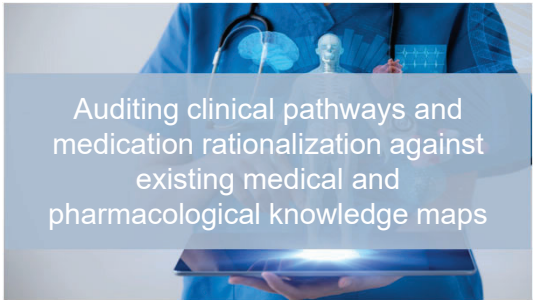
Insufficient Capacity

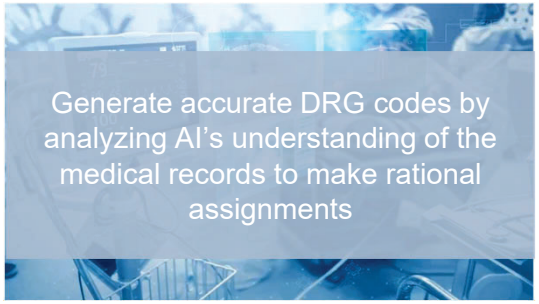
Under the DRG payment system reform, the weak coding skills of staff in medical records departments and the difficulty of preparing DRG codes have led to uneven quality of cases.

Insufficient Solutions

Excessive medical practices and health insurance fraud are difficult to detect by the existing health insurance system.

Electronic Medical Records Quality Control System





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Intelligent Health Insurance Solutions

National Healthcare Security Administration (NHSA)

Medical Insurance Designated Hospital/ Pharmacies

Supervisors for the Healthcare Security Fund

In-process Supervision

Alert hospitals to possible medical insurance risks and issues prior to billing

Assist NHSA in auditing and supervision of the medical insurance fund usage

Prior Audit

Intelligent Health Insurance Solutions

Capacity Enhancement

Promote the rationalization of the healthcare security funds usage

Enhance the compliance capacity and treatment quality of hospitals, and effectively circumvent excessive medical care and insurance fraud

Comprehensive Analysis

Including violation analysis, credit system analysis, etc.

Source: Frost & Sullivan Analysis

Pain Points and Policy Analysis of First Page and Settlement of Medical Records

Pain Points Analysis

First Page of the Medical Records

Insufficient Qualified Staff: Coders are understaffed

- Some low-grade hospitals do not have coders and existing coders are inexperienced, not systematically trained, and unfamiliar with coding rules or ICD diagnostic rules.

Insufficient Capacity: Failure to implement DRGs as required

- Hospitals did not implement quality control measures in accordance with DRGs requirements, resulting in low medical records quality.
- Some clinicians and administrators lack theoretical knowledge of DRG application and lack proven DRG analysis tools.

Insufficient Solutions: Lack of scientific management

- Some items lack clear definitions and the codes are not uniform.
- Clinicians writing medical records lack timely audit prompts or coding reference screening, repeated modification of filing leads to inefficiency.

Settlement List

Difficulty in settlement in other locations

- Regional health insurance policies vary greatly.
- Some special diseases have not realized inter-provincial settlement.
- The rights and responsibilities for supervising medical treatment in other places are not clear enough, and irregularities occur frequently.

Deficiencies in the settlement list management model

- Capture type: The settlement list is exported directly from the first page of the case. The exported list may not comply with the reporting standard, resulting in wrong grouping or medical records discrepancy. And this model lacks the audit and supervision of the medical insurance department.
- Fill-in type: Clinicians fill in the settlement list, and the insurance department performs the supervision and management function. Clinicians may choose the diagnosis with higher payment as the primary diagnosis for the purpose of obtaining higher payments, resulting in excessive medical expenditures.

Relevant Rules and Policies

2021.1 | Quality Control Indicators for Medical Records Management

- Requiring all levels of health departments to adopt information technology to strengthen the guidance of collection, analysis and feedback of medical records projects, and to improve the quality of medical records management.
- Mandating the standardization of clinical diagnosis and treatment, the promotion of standardization and homogenization of medical services, and the continuous improvement of the scientific and refined level of quality management of medical cases.

2021.2 | Medicare Fund Settlement List, Guidelines for Completion of the Medicare Fund Settlement List

- A series of requirements have been put forward to improve the quality control of basic information, enhance data management capabilities, and further standardize the completion of the medical insurance settlement list.

2021.3 | Thirteenth National Committee of the CPPCC

- Suggesting that upgrading the level and scale of the training of coders in universities as well as strengthening continuing and on-the-job education in coding industry would help to upgrade the capacity of caseworkers.

2022.7 | Notice on Further Improving the Work of Direct Settlement for Cross-provincial Medication for Basic Medical Insurance

- Calling for improving the policy of direct settlement of cross-provincial medicine, standardizing management services, strengthening fund management, and enhancing the standardized support of medical insurance information.

Source: Government Notices, Frost & Sullivan Analysis

Case Analysis of Major Players in Intelligent Health Insurance Solutions in China

- Under the guidance of a series of policies issued by the government on hospital cost control, medical insurance payment management, and DRG/DIP payment method reform, various types of players in China's healthcare field have also entered the intelligent health insurance track. Through covering the hospital side of medical records quality control, intelligent operation or the intelligent audit and medical insurance fund payment control on the side of the bureau, the hospital's after-the-fact management is moved forward to beforehand and during the event, and the bureau side assists in the supervision of the health insurance fund. According to industry layout and business coverage, the market players can be split into traditional and emerging solution providers.

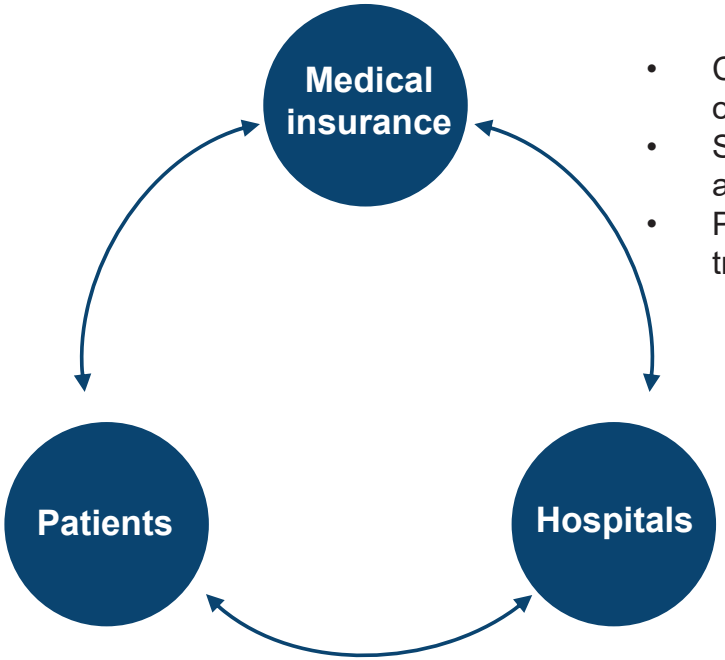
	Traditional Solution Providers	Emerging Solution Providers
Industry Layout	• Layout in the medical field earlier, mostly with HIS systems, electronic medical records and other hospital information systems to start, in the hospital side of the customer and data accumulation deeper.	• Entered the healthcare and health insurance tracks in the policy-driven context of recent years, with a significant resource advantage in a certain regional area.
Business Model	• Adopting a "top-down" market strategy, i.e., covering the bureau-side and regional market first, establishing market reputation and customer adhesion such as quality control rules, and then pushing the hospital end of the market.	• Take advantage of the regional advantage to take a certain province or cities as the core and radiate to the periphery to promote the customer coverage of health insurance bureaus and hospitals simultaneously.
Strengths Analysis	• Certain first-mover advantage by virtue of years of customer accumulation, knowledge base and rule base data accumulation.	• With AI, data infusion and other technology-enabled solutions, it has a certain latecomer's advantage
Major Players	卫宁健康 Winning Health; 国新健康; Neusoft; 久远银海 JIUYUAN YINHAI; 易联众	• Providers with core competence in a particular field, eg. Medical records quality control or intelligent encoding: Kindo ADEN; VIEW HIGH; 科大讯飞 iFLYTEK | 讯飞医疗 • Whole-chain solution providers: 火树科技

Source: Frost & Sullivan Analysis

Overview of Diagnosis-related Group (DRG) - I

- DRG is an internationally recognized effective way to control hospitalization expenses. It is a patient classification system that standardizes prospective payment to hospitals and encourages cost containment initiatives, so that DRG mode can help prevent excessive treatment and overuse of medicines and examinations. At the same time, since DRG payment limited the hospital income of each disease type, Class III hospitals will strive to improve medical quality to achieve higher points and incomes, so that patients with some chronic diseases which require long-term care will have referrals to primary hospitals, which objectively promote hierarchical diagnosis and treatment system
- DRG payment mode was first applied in the U.S. to improve national healthcare service efficiency and quality. As China healthcare management system moves towards scientization, standardization and systematization, it started to conduct the regional DRG pilot project in 2016 in the area with solid medical foundation.

Win-win situation under DRG payment



- Control medical expenses without overspending
- Save medical insurance fund and avoid medical resource waste
- Promote hierarchical diagnosis and treatment

- Benefit from high quality medical service
- Reduce disease financial burden especially for inpatients

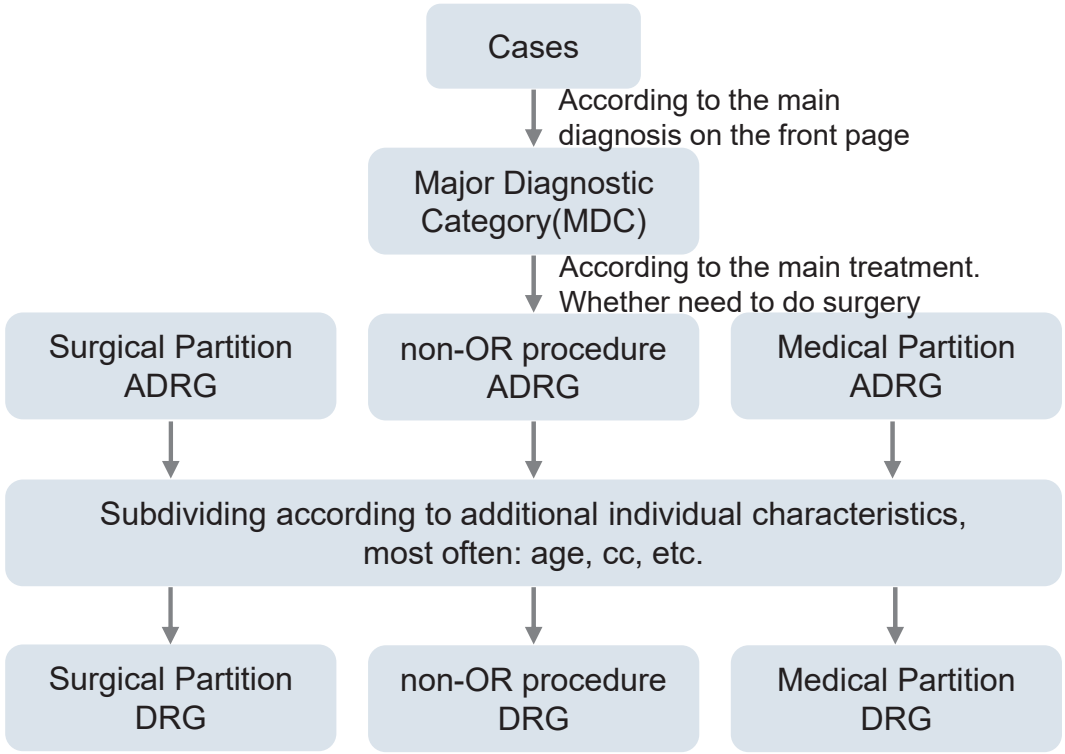
- General Practice diagnosis and treatment behavior
- Increased transparency of medical service quality where each hospital can easily find the advantages and disadvantages

Source: NHSA, Frost & Sullivan Analysis

Overview of Diagnosis-related Group (DRG) - II

- DRG divides inpatients into a certain number of disease groups according to the severity of the diseases, the complexity of the treatment methods, and the homogeneity of the resource consumption to achieve the goal of fine management. CHS-DRG grouping adopts the idea of case mix. Firstly different disease types should be distinguished by diagnosis to get MDC groups, then similar cases with different treatment methods should be distinguished by whether to take surgical operation or not. Thirdly, if similar cases are treated in the same way, but the individual characteristics of the cases are different. It should also be subdivided by age, weight and complication and so on to finally form DRG group. CHS-DRG would often be further adjusted or subdivided by local government to meet the regional situation.
- To fully realize the application value of DRG, there must have a uniform coding principle and reasonable grouping mechanism. It is also inseparable from the support of professional clinical team.

DRG Grouping Database Summary

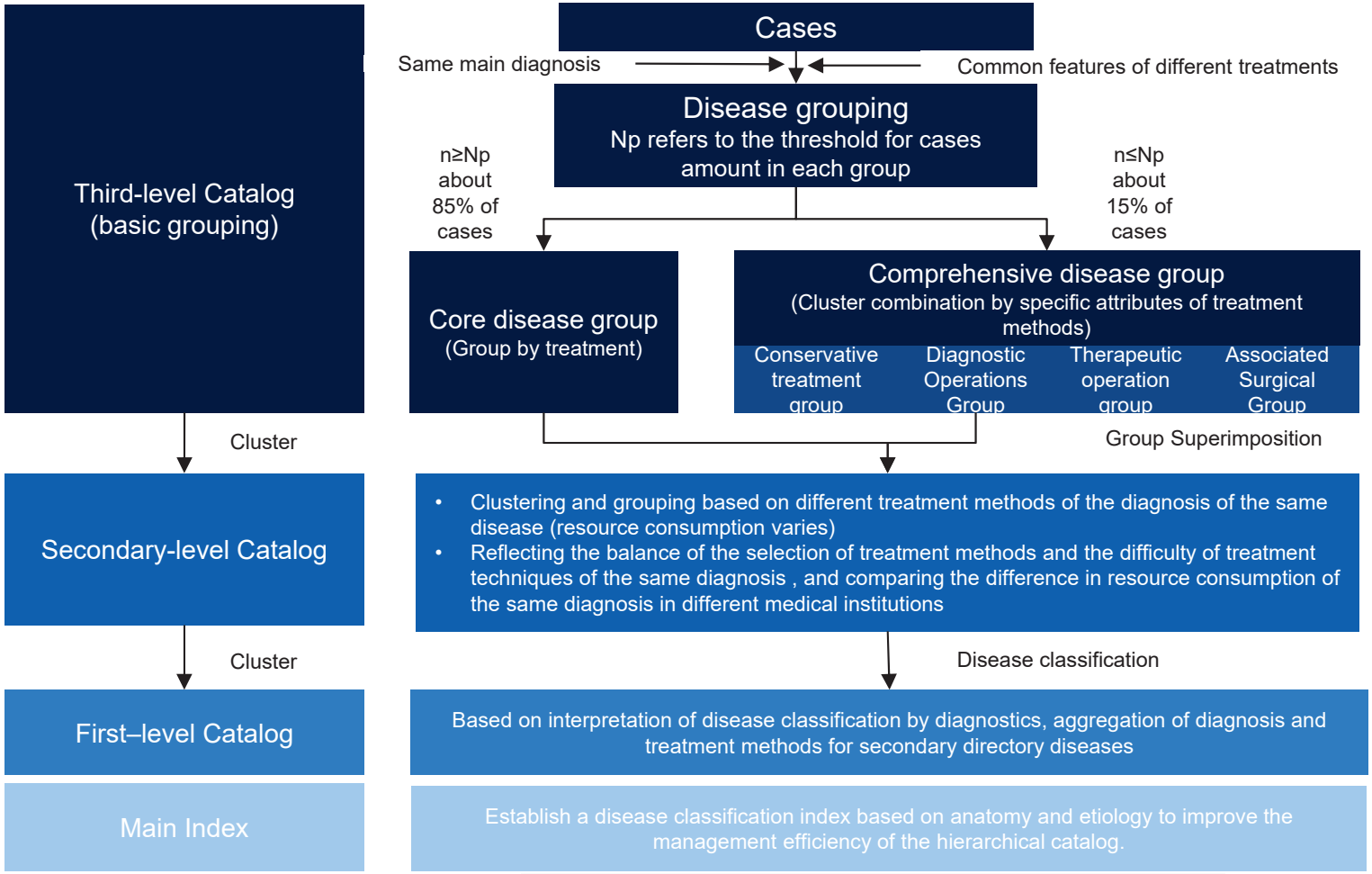


Note:
OR: operating room;
ADRF: Adjacent Diagnosis Related Groups;
CC: Complication & Comorbidity

Source: NHSA, Frost & Sullivan Analysis

Overview of Diagnosis-Intervention Packet (DIP)

- Diagnosis-intervention packet (DIP) is a complete management system established by utilizing the advantages of big data. It explores the common characteristics of "disease diagnosis + treatment" to objectively classify medical record data. The disease grouping of DIP includes a main catalog and an auxiliary catalog, and the main catalog is composed of core diseases and comprehensive diseases.



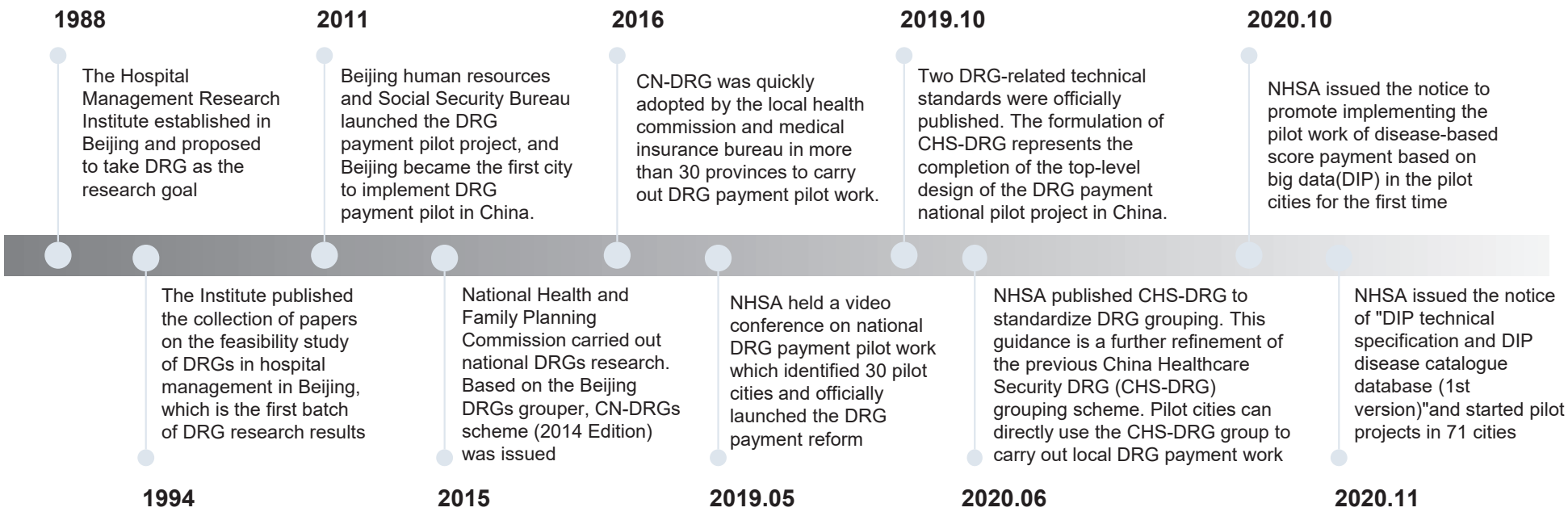
Influence on Pharmaceutical Industry

- The overall growth rate of inpatient treatment costs has declined, and the opportunity for domestic enterprises lies in import substitution in hospitals
- The development of pharmaceutical innovation is supported
- Support the use of new technologies
- Promote the development of traditional Chinese medicine
- Companies of generic drugs are encouraged to pay close attention to health economic analysis and competitive differentiation strategy

Source: Frost & Sullivan Analysis

Development of DRG Reform in China

- After years of efforts, China has successfully established a basic medical insurance system with a coverage rate over 95%, where 1.3 billion people benefit from that. However, China still faces a number of challenges, especially the huge financial burden. How to reduce medical costs while ensuring the quality of medical services has become a hot topic, therefore diagnosis-related group (DRG) and diagnosis-Intervention packet (DIP) payment scheme has been introduced.
- In the new round of health reform, the medical payment reform is one of the core measures, in which DRG payment is considered as an important alternative to the conventional fee-for-service (FFS) payment method and a vital component in the mixed payment system for hospitals. In fact, China has started DRG research in 1994. Being restricted by history condition of backward hospital management mode and information construction, the development of DRG is slow, even once stagnant, until 2009 where the state council issued opinions on deepening the reform of the healthcare system. The policy clearly points out that the reform should focus on hospital management and electronic medical records, and vigorously promote hospital information construction. The problem of electronic data that plagued DRG research and development has been worked out. In the following years, the pilot work of DRG payment was gradually started. On the basis of DRG, the introduction and implementation of DIP are more rapid. By the end of 2021, actual payment will be carried out in 30 pilot cities using DRG payment scheme and in 71 pilot cities using DIP payment scheme.



Source: Frost & Sullivan Analysis

Development of DRGs in the United States

- The original Diagnosis-Related Grouping System (DRGs) was a payment program that linked specific types of disease to the costs of the care they consumed, which was used to group inpatients based on the level of cost and similarity of their conditions.This system has made a great contribution to the fair and efficient allocation and management of health resources.

Milestones of DRGs

1973 The first edition of the DRG was released, containing 54 major diagnostic categories and 333 DRG groups.

1980 New Jersey first implemented a DRG-based payment system in Medicare and gradually promoted it to other states.

1987 New York State set up a plan to apply DRGs to other types of insurance by commissioning 3M Health Information Systems to conduct research and develop new DRGs.

2007-2008 Medicare began implementing a DRG system categorized by disease severity: the Medicare Severity-DRG (MS-DRG).

2015 The diagnosis and procedure information is reported by the hospital using codes from the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) and the International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS).

2020 In response to the COVID-19 outbreak, the Centers for Disease Control and Prevention has included a new diagnosis code, U07.1, COVID-19, in the International Classification of Diseases, Tenth Clinical Revision (ICD-10-CM). In the updated MS-DRGs version 37.2, 12 DRGs have been updated to describe infections and associated treatments.

Development of DRGs

1. **DRGs: Yale-DRGs, the birth of DRGs.**
   - Studied by Yale University Mill et al.
2. **REFINED- DRGs: utilized ICD-9-CM classification codes**
   - ICD-9-CM classification codes were adopted.
   - Patients were categorized into four levels according to the complexity of complications and comorbidities.
3. **ALL-PATIENT-DRGs: 3M updated the DRGs.**
   - The New York State Department of Health, in collaboration with 3M Health Information Systems, revised and updated the DRGs to provide more detailed categorization.
4. **SEVERITY DRGs: refinement of additional diagnostic content.**
   - The additional diagnoses were categorized into no complications and comorbidities, no major complications and comorbidities, and severe complications and comorbidities.
   - Fourth-generation DRGs ultimately did not work on Medicare in the United States for reasons.
5. **ALL-PATIENT REFINED-DRGs: subgroups added**
   - Subgroups were used to describe the severity of the illness of the patient and the risk of the patient's death; each of these two aspects was divided into four levels: mild, moderate, severe, and very severe.
6. **MS-DRGs: categorize disease severity.**
   - CMS uses MS-DRGs (Medicare severity-diagnosis-related groups), which combines factors such as disease severity and resource consumption to classify cases into different DRG groups.

Source: Literature Review, CMA, Frost & Sullivan Analysis

Favorable Policies/ Regulations (1/4)

Review of Medical Insurance Cost Control

Release Date	Issuing Authority	Policies	Comments
Jun, 2017	General Office of the State Council	*Guiding Opinions of the General Office of the State Council on Further Deepening the Reform of Basic Medical Insurance Payment Methods* 《国务院办公厅关于进一步深化基本医疗保险支付方式改革的指导意见》	• Emphasis on promoting Diagnosis-Intervention Packet (DIP): In principle, DIP will be implemented for diseases with relatively clear diagnosis, hospital access standards, relatively mature diagnosis and treatment technology; Establish a well-coordinated connection between DIP and payment policies, rationally determine billing and payment standards, and share the cost between the medical insurance fund and individuals.
May, 2021	General Office of the State Council	*Circular of the General Office of the State Council on the Issuance of the 2021 Key Tasks for Deepening the Reform of the Medical and Health Care System* 《国务院办公厅关于印发深化医药卫生体制改革2021年重点工作任务的通知》	• Promote the reform of medical insurance payment mode: promote the trial of DRG(Diagnosis-Related Groups)-based, DIP (Diagnosis-Intervention Packet)-based payment mode, and promote fine management, and summarize experience in due and promote it nationwide.
Sep, 2021	General Office of the State Council	*"The 14th Five-Year" Plan for Universal Health Care Coverage* 《 “十四五” 全民医疗保障规划》	• Continuously deepen the reform of medical insurance payment mode: implement a diversified, compound medical insurance payment model based on Diagnosis-Intervention Packet (DIP) throughout the country.
Nov, 2021	National Healthcare Security Administration	*Three-year action plan for DRG/DIP payment methodology reforms* 《DRG/DIP支付方式改革三年行动计划》	• From 2022 to 2024, the DRG/DIP payment reform should be fully completed to promote the high-quality development of medical insurance. By the end of 2024, the DRG/DIP payment reform will be carried out in all the coordinating areas of the country, and the pilot areas that were launched in the early stage will continue to consolidate the reform achievements. By the end of 2025, DRG/DIP payment will cover all eligible medical institutions that carry out inpatient services, and basically achieve full coverage of diseases and Medical Insurance Fund (MIF).
Mar, 2023	General Office of the State Council	*Opinions on further improving the medical and health service system* 《关于进一步完善医疗卫生服务体系的意见》	• Advance the medical insurance payment mode reform and improve the multicomposite medical insurance payment mode. Improve the medical insurance payment mode in line with the characteristics of traditional Chinese medicine. Explore the implementation of total payment for close medical consortium, strengthen supervision and assessment, implement surplus retention and reasonable overspending sharing.

Source: Government Website, Frost & Sullivan Analysis

Favorable Policies/ Regulations (2/4)

Review of Medical Insurance Payment System

Release Date	Issuing Authority	Policies	Comments
Jul, 2018	NHC, MoHRSS, MoF	*Notice for Improving Basic Medical Insurance for Urban and Rural Residents in 2018* 《关于做好2018年城乡居民基本医疗保险工作的通知》	• In 2018, the standard of financial subsidy and individual payment of medical insurance for urban and rural residents was raised simultaneously.
Oct, 2018	National Healthcare Security Administration	*The inclusion of 17 drugs in the national basic medical insurance, industrial injury insurance and maternity insurance category B* 《关于将17种药品纳入国家基本医疗保险、工伤保险和生育保险药品目录乙类范围的通知》	• China has included 17 more cancer drugs in its national basic medical insurance program, among 44 selected cancer drugs for negotiations on lowering their prices and inclusion in the list of drugs eligible for reimbursement through the medical insurance program.
Nov, 2019	MoHRSS	*Notice for the inclusion of 2019-Negotiations-Drugs in List B of the National Basic Medical Insurance, Industrial Injury Insurance and Birth Insurance Catalogue* 《关于将2019年谈判药品纳入国家基本医疗保险、工伤保险和生育保险药品目录乙类范围的通知》	• Included 97 successful negotiations drugs (70 new drugs + 27 renewal drugs).
Dec, 2020	National Healthcare Security Administration	*Catalog for National Basic Medical Insurance, Work-related Injury Insurance and Maternity Insurance, 2020* 《国家基本医疗保险、工伤保险和生育保险药品目录(2020年)》	• There are 2,800 drugs in the list, involving 1,264 western drugs and 1,315 traditional Chinese drugs. There are also 892 kinds of Chinese herbal medicine. • This catalog adjustment is the first attempt to negotiate a price reduction for the drugs in the catalog.
Dec, 2021	National Healthcare Security Administration	*Catalog for National Basic Medical Insurance, Work-related Injury Insurance and Maternity Insurance, 2021* 《国家基本医疗保险、工伤保险和生育保险药品目录(2021年)》	• There are 2,860 drugs in the list, involving 1,486 western drugs and 1,374 traditional Chinese drugs. There are still 892 kinds of Chinese herbal medicine. • 74 new drugs were added to the catalog and 11 drugs were removed from the catalog. The newly-added drugs accurately complement the medication needs of tumors, chronic diseases, anti-infections, rare diseases, women and children.

Source: Government Notices, Frost & Sullivan Analysis

Favorable Policies/ Regulations (3/4)

Review of Supervision System of Healthcare Security Fund (1/2)

Release Date	Issuing Authority	Policies	Comments
Nov, 2018	National Healthcare Security Administration	*Notice on the Current Work on Strengthening the Management of Medical Insurance Agreements to Ensure Fund Security* 《关于当前加强医保协议管理确保基金安全有关工作的通知》	• Strengthen supervision responsibility, serious accountability in accordance with the law: unblock reporting and complaint channels, encourage social supervision, and promote all parties in society to report fraud and defrauding medical insurance funds. It is necessary to organize and carry out comprehensive supervision, strengthen coordination and cooperation with public security, health, drug supervision and other departments, in order to form a regulatory force.
Jul, 2020	General Office of the State Council	*Guiding Opinions on Promoting the Reform of the Supervisory System System of the Medical Security Fund* 《关于推进医疗保障基金监管制度体系改革的指导意见》	• Comprehensively establish an intelligent monitoring system: in view of the characteristics of fraudulent insurance behaviors, constantly improve the basic information standard database such as drugs, diagnosis and treatment items and medical service facilities and clinical guidelines and other medical knowledge bases, improve intelligent monitoring rules, and enhance intelligent monitoring functions. Accelerate the establishment of a centralized and unified intelligent monitoring system at the provincial level and even the national level, and realize the transformation of fund supervision from manual drawing audit to big data all-round, whole-process, whole-link intelligent monitoring.

Source: Government Notices, Frost & Sullivan Analysis

Favorable Policies/ Regulations (4/4)

Review of Supervision System of Healthcare Security Fund (2/2)

Release Date	Issuing Authority	Policies	Comments
Feb, 2021	General Office of the State Council	*Regulation on the Supervision and Management of the Use of the Medical Insurance Fund* 《医疗保障基金使用监督管理条例》	• Article 24: The medical insurance administrative department shall strengthen information exchange and sharing with relevant departments, innovate supervision and management methods, promote the use of information technology, establish a national unified, efficient, compatible, convenient and safe medical security information system, implement real-time dynamic intelligent monitoring of big data, and strengthen the management of the whole process of the use of shared data to ensure the security of shared data.
Nov, 2022	National Healthcare Security Administration, etc.	*Reward Scheme for Reporting Illegal and Illegal Use of the Medical Protection Fund* 《违法违规使用医疗保障基金举报奖励办法》	• By mobilizing social forces to participate in the supervision of the medical insurance fund to safeguard the security of the medical insurance fund and the legitimate rights and interests of citizens
May, 2023	General Office of the State Council	*Implementation Opinions on Strengthening the Standing Supervision of the Use of the Medical Protection Fund* 《关于加强医疗保障基金使用常态化监管的实施意见》	• Implement regular regulation: Innovate supervision methods, strengthen intelligent monitoring and big data supervision applications, and build a technical defense line for the whole process of advance reminder, in-process audit, and post-supervision.

Source: Government Website, Frost & Sullivan Analysis

Value Analysis of Intelligent Medical Insurance Solutions

Timely Alerts at the Prior Audit Session

- With the deepening of health insurance supervision, the volume of health insurance data is getting bigger and bigger, and the traditional manual audit of the hospital case department is inefficient and incomplete, so there is an objective demand for intelligent technology to assist in auditing cases in hospitals.
- The application of AI technology in the hospital's health insurance supervision can prompt the hospital of possible health insurance risks and problems before the settlement of health insurance, and help the hospital to improve its compliance ability and diagnosis and treatment quality through prior pre-auditing.

Deterring Overmedication and Insurance Fraud

- The tightness of medical insurance funds has led to more and more stringent medical insurance fee control in hospitals, and the supervision of medical insurance funds has also been further increased. The application of intelligent medical insurance in the medical insurance bureau empowers in the supervision link, cracks down on excessive medical care and insurance fraud, improves the efficiency of the bureau's audit, and realizes the dual goals of medical insurance fee control and fund supervision.

Save labor costs by accumulating audit experience through machine learning

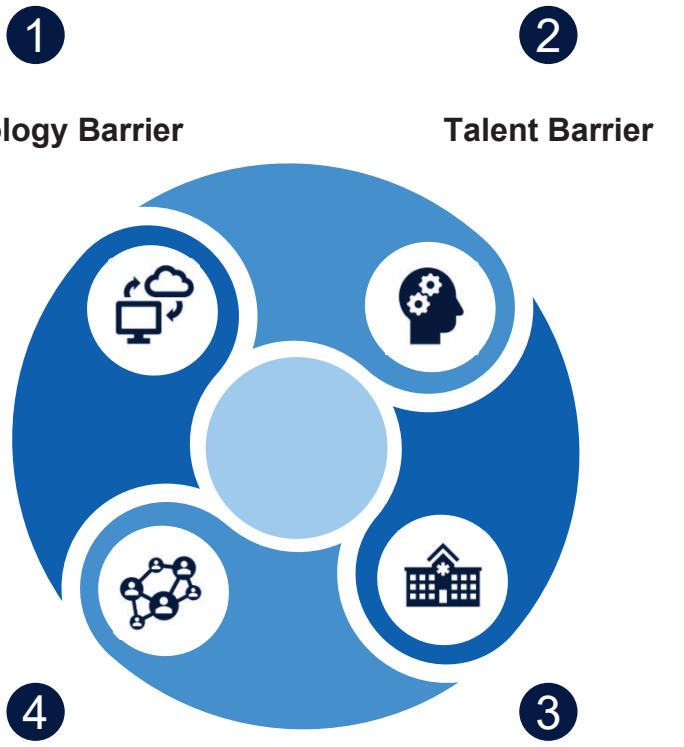
- Based on big data and artificial intelligence, Intelligent Health Insurance is able to provide intelligent audit services for hospitals and health insurance bureaus at a lower labor cost, and at the same time, it is able to accumulate and precipitate case management experience, and optimize the regulatory model through continuous iteration to adapt to health insurance-related policies.

Source: Frost & Sullivan Analysis

Entry Barriers of Intelligent Medical Insurance Solutions

- Commercialization capability is a key element of smart health insurance, while technical support, integrated talent, customer accumulation and cross-regional processing are both critical elements and barriers for successful industry entry and commercialization expansion, especially for new players.

Entry Barriers Analysis



1
- The processing and analysis of medical insurance data needs to be divided into at least three steps: element extraction, connotation understanding and intelligent reasoning, which requires the system to have accumulated artificial intelligence in medical connotation.
- On the other hand, since each hospital has different inventory data and needs, it is necessary to open different functional privileges for different customer needs on the basis of a standardized product, which is extremely complex.

2
- As the Internet healthcare industry itself integrates the business attributes of both the Internet and medical fields, there is a very strong demand for integrative talents with the attributes of the two industries at the same time, so its talent cultivation system has the attribute of strong industry barriers.

3
- Early large-scale basic systems such as HIS for tertiary hospitals and other types of specialized systems have been basically completed, the undertaking enterprise has accumulated customer resources and technical experience, to complete the "enclosure".
- For reasons of mutual trust, data security, learning costs and so on, the medical institutions also tend to prefer the original cooperation vendors, which hinders the enhancement of industry concentration.

4
- Different regions covered by health insurance have information and data barriers, and there are drawbacks such as different standards for health insurance information systems, inaccessible data, segmented systems, and regional closures, thus creating barriers to cross-regional handling due to the cumbersome operation of independent business systems.

Source: Frost & Sullivan Analysis

Growth Drivers and Future Trends of Intelligent Medical Insurance Solutions

New Payment Methods, Medical Cost Control and Other Top-Level Policies Accelerate the Penetration of Intelligent Health Insurance in NHSA and Hospital	• In order to reduce or reasonably control the costs of medical services, the government has successively introduced policies related to new payment methods, medical fee control and medical insurance supervision. However, in the process of policy implementation, the problems of insufficient manpower, capacity and means in the review and settlement of medical cases have been gradually exposed. • Intelligent medical insurance can effectively solve the current difficulties in medical insurance auditing and settlement by providing pre-alert, in-process warning, post-supervision and analysis, and meanwhile empowering NHSA and hospitals to apply AI supervision technology to crack down on all kinds of irrational use of medical insurance funds. In the future, there is a huge potential market especially in medical insurance bureaus and hospitals.
The application of intelligent health insurance will gradually extend from in-hospital to out-of-hospital scenario.	• More than half of China's annual health insurance fund expenditure pays for chronic diseases, so the cost control for chronic diseases has become a top priority. Since chronic diseases are more focused on post-discharge management, the future intelligent health insurance will explore the business mode of extending from in-hospital to out-of-hospital, and gradually expand from out-of-hospital chronic disease management to health management, to comprehensively supervise the rational use of health insurance funds.
Collaborate with all Participants to Achieve the Combination of Active and Passive Cost Control	• It is hard for hospitals and doctors to initiatively control medical costs, leading to many cases of inducing demand and excessive medical behaviors, which makes it difficult to guarantee the quality of services and the rational use of the health insurance fund. Under the premise of ensuring the quality of medical services, intelligent health insurance could collaborate with participants, doctors, medical institutions and regulators to realize the combination of active and passive cost control, and comprehensively improve the effectiveness of the use of the health insurance fund.
More companies with competitive AI strength will enter the medical vertical field and lay out intelligent health insurance products.	• Encouraged by the national macro policy and the rapid development of big data, the future potential market of the AI healthcare is huge, and the application of AI in the medical records review and health insurance cost control has become the exploration direction of many AI companies, such as iFlyHealth (讯飞医疗), ViewHigh (望海康信), and iMEDWAY (东华医为). With the entry of more new players in the future, the application of AI in the field of health insurance will also become more mature.

Source: Frost & Sullivan Analysis

Table of Content

Overview of AI in Hospitals (1/2)

- The application of AI in hospitals is extensive, and can be broadly divided into two categories according to the purpose of application, namely, the application for the purpose of enhancing hospital operations and the application for the purpose of enhancing the diagnosis and treatment ability of doctors and standardizing medical behavior.

Typical AI Empowered Applications in Hospitals

Enhancement of Hospitals' Operations and Patient Experience

- Patient Guidance System
- Medical History Collection
- AI Virtual Assistant
- Follow-up Visit Reminder

Improvement of Doctors' Medical Capabilities

- CDSS (General Practice CDSS, Specialized CDSS, PASS)
- AI EMR Quality Control
- AI Medical Imaging Software (Diagnosis and Treatment)

Source: Literature Review, Company Official Websites, Frost & Sullivan Analysis

Overview of AI in Hospitals (2/2)

- AI solutions in hospitals target at the current problems in the treatment procedures of the patients and are dedicated to enhance the patients' experience and alleviate the conflicts between supply and demand in hospitals.
- The solutions applicate in the main three phases including pre-diagnosis, intra-diagnosis and post-diagnosis.
- The main functions of the Intelligent Medical Solutions include improving the efficient of the entire medical system, providing the foundation of high quality development of the hospitals.

The Application Scenarios

Pre-Diagnosis

AI Virtual Assistant

The function includes pre-screening triage, department search, expert search, etc.

AI Medical History Collection

Through dialogues the AI medical robots could precisely collect patients' medical history.

Intra-Diagnosis

CDSS

AI Clinical Decision Supporting System provides patient-specific, evidence-based advice and health care to support doctors.

AI Medical Imaging

AI medical imaging can assist physicians in clinical workflows by performing complex pattern data recognition.

AI E-Case

In the diagnosis period, the medical case could be recorded automatically by voice simultaneously.

AI In-hospital Mobile Workstation

A workstation designed for hospital internal management, communication between doctors and nurses, and management of patient information.

Post-Diagnosis

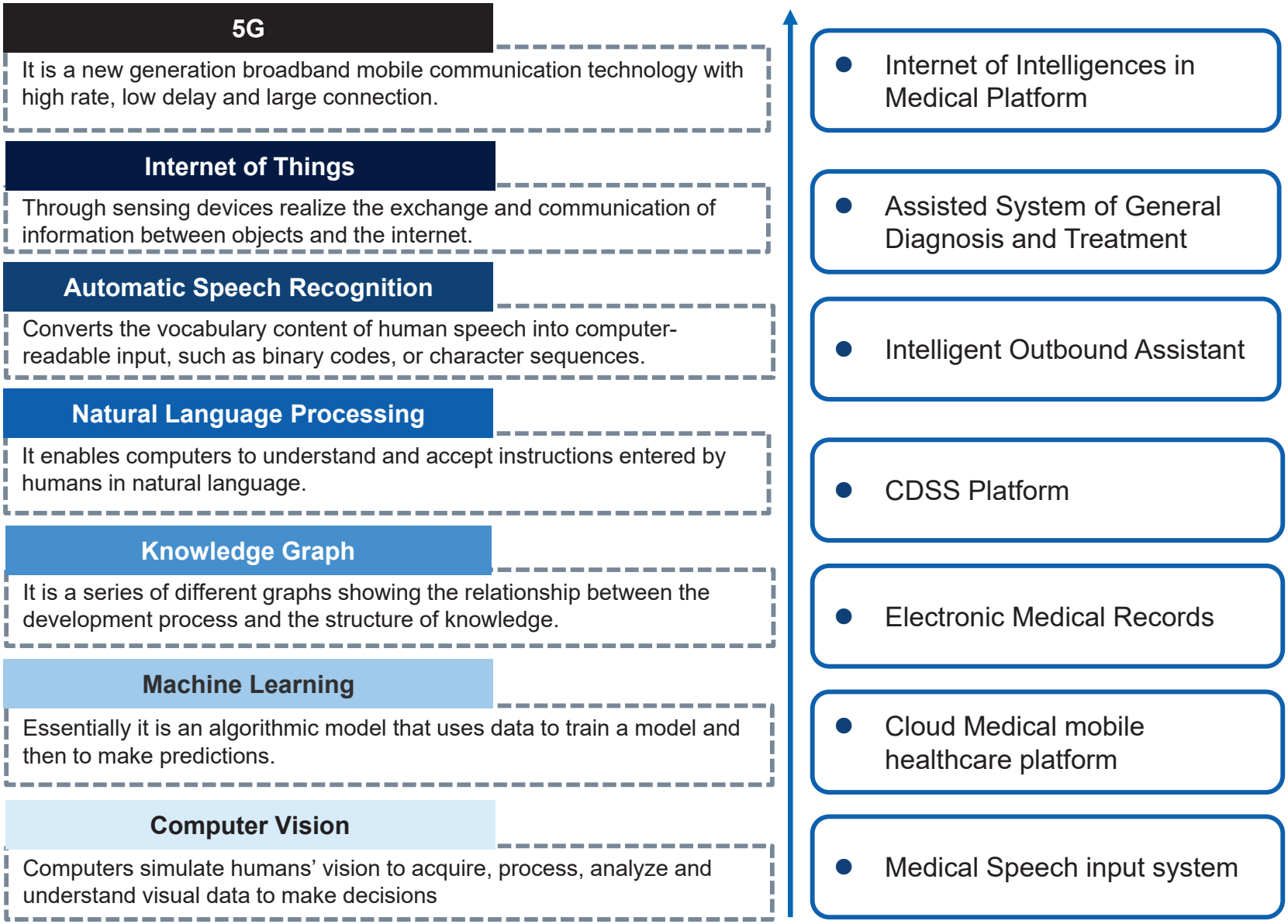
AI Hospital Follow-up System

Post-Diagnosis Management

The AI hospital follow-up system, along with the data collected pre- and intra- diagnosis, can support doctors and patients in terms of post-diagnosis management of diseases or conditions such as chronic diseases.

Source: NHC, Frost & Sullivan Analysis

Core Technology of AI in Hospitals



Source: Frost & Sullivan Analysis

Analysis of Pain Points of Hospital Services and the Value of AI in Hospitals

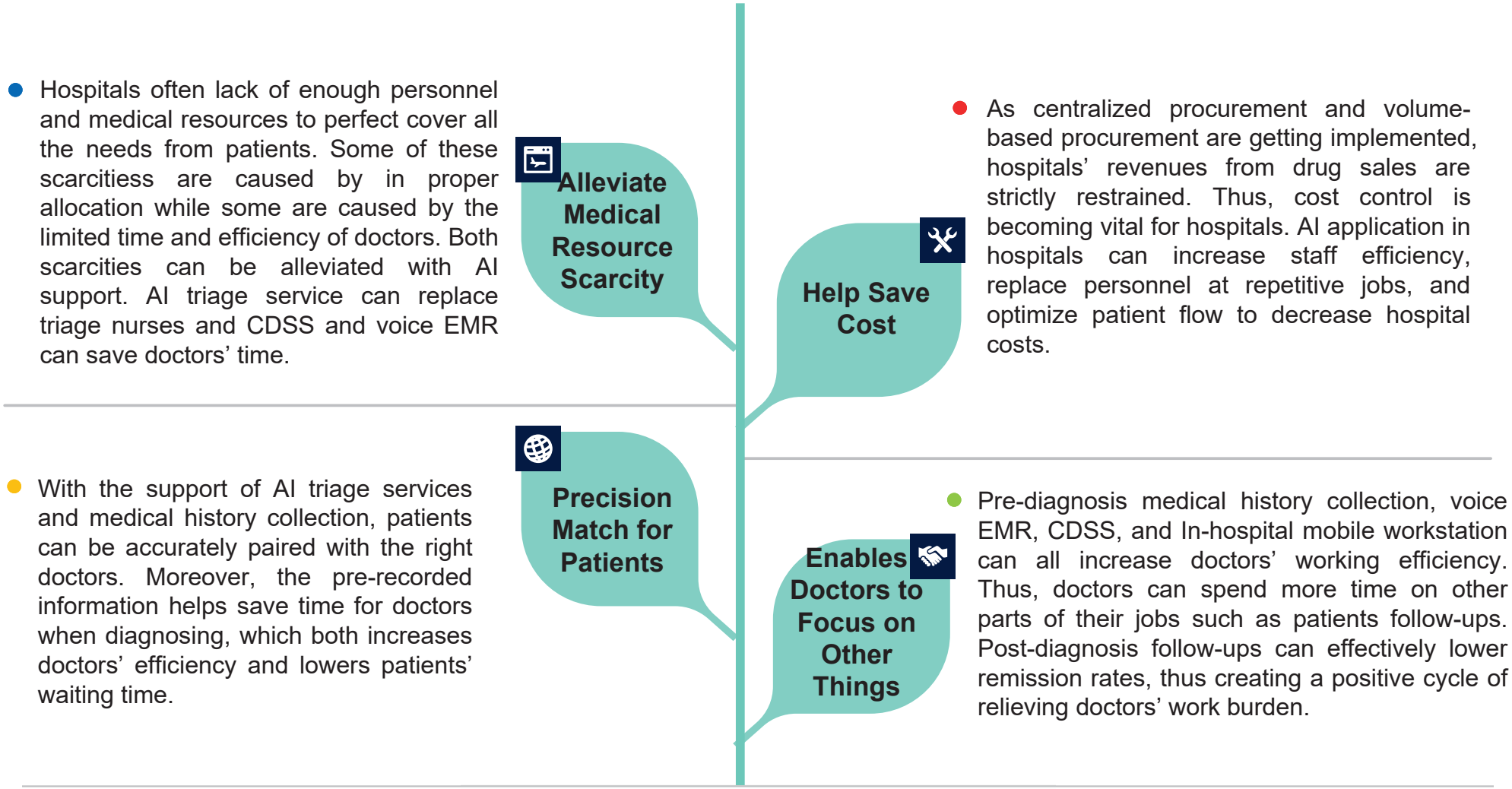
	Pain Points of Healthcare Services in Hospitals	Value Analysis of AI in Hospitals
Imbalanced Distribution of Medical Resources	• The allocation of medical resources among hospitals at various levels is unreasonable, with high-level specialist doctors and advanced equipment tilted towards top hospitals. • The mechanism of tiered diagnosis and treatment is not perfect, and the reform of two-way referral and up-and-down linkage has not yet been completed. The phenomenon of insufficient total medical resources coexists with localized waste.	• The health service system built with AI medical care can firstly enhance the utilization rate of medical resources, and intelligent doctor-patient matching can allow doctors to make more effective use of their resources. • Secondly, the use of intelligent reservation system can make timely planning for triage and referral and improve the efficiency of medical consultation.
Difficulties in Managing Hospitals at Multiple Levels	• Hospital management is very complex, especially high-level general hospitals may involve more than a dozen different management directions, such as medical quality management, teaching and research management, human resources management in hospitals, doctor-patient communication management, medical information management, nursing management, pharmacy management, etc.. It is difficult to take into account the requirements of quality, safety, cost and efficiency.	• AI healthcare is expected to solve the problem of insufficient and unbalanced allocation of medical resources, and improve the efficiency and experience of the whole process of healthcare. • Provide consultation advice through intelligent guidance to help patients find suitable hospitals and departments more quickly and accurately, and fully utilize the role of first diagnosis and first treatment for common and frequent diseases. • Provide preliminary diagnostic advice to patients through remote diagnosis.
The Problematic Legacy of "Healthcare Data Silos"	• In recent years, it is still difficult to realize the credible circulation of patients' electronic medical records and diagnostic imaging reports across hospitals within many medical clusters. • At the same time, with the increase in the policy of personal privacy protection and the highlighting of the value of medical data resources, the sharing and circulation of medical data is still confronting some new challenges.	• In response to the demand for chronic disease management, AI healthcare can establish personal electronic health records for the chronic disease population through a variety of intelligent health testing equipment, provide early screening of chronic disease, early warning of chronic disease risk and comprehensive intervention, promote the sinking of high-quality healthcare resources, and enhance the fairness and accessibility of medical and healthcare services.
Imperfect "Two-Way Referral" Mechanism	• Firstly, there is wide disparity and poor continuity of services between medical institutions at all levels, such as inadequate rationing of medicines in primary medical institutions. • Second, information platforms are not shared among medical institutions at all levels, and the problem of "medical data silos" is not conducive to patient referrals. • In addition, high-level hospitals are under pressure to generate revenue and lack incentives to release patients due to the distribution of benefits.	• The referral appointment platform of AI healthcare can realize the standardization and informatization of the referral process, including referral decision-making, communication and liaison, overall assessment, emergency management, and information handover. • Secondly, the referral appointment platform can realize the effective integration of medical resources, up and down linkage, interoperability and information symmetry among referral units at all levels. • In addition, it also realizes the full management of referral.

Source: Frost & Sullivan Analysis

Value Analysis of AI in Hospitals

Core Value of AI in Hospitals

The core value of AI in hospitals resides with AI's capability to achieve a high level efficiency with limited resources, which addresses many pain points of the current hospital system in China.



Source: Frost & Sullivan Analysis

Overview of AI Applications in Hospitals with the Interaction of Patients

- In-hospital AI doctor-patient interaction applications cover the entire process of pre-diagnosis, diagnosis and post-diagnosis, including a variety of services such as pre-diagnosis AI triage services, medical history taking services, in-diagnosis AI medical imaging, and post-diagnosis intelligent follow-up visits.
- Service providers may vary in their level of technology, with some offering voice interaction to further speed up the triage process and enhance the user experience. Some of these service providers offer comprehensive hospital smart healthcare solutions, with pre-diagnosis systems often connected to other systems such as EMRs, HISs and even post-diagnosis patient follow-up systems.

Pre-diagnosis Services

- Pre-screening Triage
- Health Education
- Department Search
- Map Navigation
- Expert Search
- Medical History Collection

In-progress Diagnosis Services

- AI Medical Imaging

Post Diagnosis Services

- Intelligent Follow-up
- Mobile Terminal Medication Reminder

Value Analysis

- Accurate guidance to corresponding departments
- Reduce outpatient queuing time
- Efficient outpatient experience

- Break down geographical constraints and improving the current uneven distribution of quality medical resources

- Build up better relationship between doctors and patients
- Improve health outcomes of patients

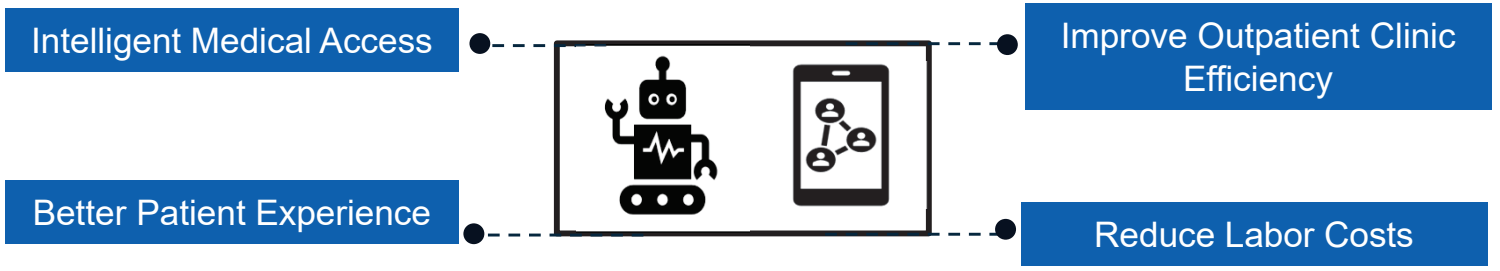
Patients Interaction

Source: Frost & Sullivan Analysis

Pain Points and Value Analysis of Pre-Diagnosis AI Solutions in Hospitals

- AI pre-diagnosis service is able to help address the pain points of current outpatient service. It solves the problem of the heavy stream of patients in outpatient situation in Class III hospitals. Meanwhile, it replaces the guiding nurses, which frees the staff from the repetitive work.
- AI pre-diagnosis service improves the efficiency and quality of patient's diagnosis experience, which is beneficial to build an information-integrated outpatient service model.

Pain Points of Current Outpatient Service	Value of AI Medical Pre-diagnosis Service
• High outpatient flow and long queues	• Result in effective diversion, and shorter time for queuing
• Correctness, coverage and satisfaction of on-site answers are not high	• Respond to questions from patients in detail by intelligent optimization
• Increasing pressure on the medical guide staffs and nurses	• Provide solutions of medical consulting and guiding, reducing labor cost



Source: Frost & Sullivan Analysis

Overview of AI Applications in Hospitals with the Interaction of Medical Staff

- The AI applications in hospitals with the interaction of medical staff cover two scenarios in hospitals and primary medical institutions, including intelligent assisted clinical decision-making, integrated doctor platform, image-assisted diagnosis, grass-roots assisted diagnosis and treatment system, cross-regional medical information sharing and service collaboration platform and other applications.
- By empowering medical staff with AI in hospitals, the value objectives of improving the efficiency of hospital medical services, standardizing medical service behaviors, and improving the quality of hospital and grass-roots medical care can be achieved. The applications mainly involve in the in-progress and post diagnosis progress such as medical records and prescriptions.

Hospitals

- Clinical Decision Support System
- Intelligent Assisted Diagnosis
- Medical Knowledge Query
- Integrated Doctor Platform
- Imaging Aids Diagnosis

Primary Healthcare Institutions

- Primary Assisted Diagnosis and Treatment System
- Medication Assistance
- Chronic Disease Management
- Cross-regional Medical Information Sharing and Service Collaboration Platform

Value Analysis

- Evaluate and improve the quality of medical care to reduce doctor-patient conflicts caused by medical errors
- Improve the efficiency for doctors in managing patients
- Standardize medical service behaviors and save medical resources
- Standardize the diagnosis and treatment behavior of primary medical personnel, and improve the level of primary medical care
- Improve the level of informatization of primary medical care
- Realize the hierarchical diagnosis and treatment mechanism at the grassroots level

Medical Staff Interaction

Source: Frost & Sullivan Analysis

Pain Points and Value Analysis of Post-Diagnosis AI Solutions in Hospitals

- AI post-diagnosis medical solutions in hospitals are able to reduce the workloads of medical staffs and elevate the operational efficiency of hospitals. The AI follow-up assistant has not only greatly improved the efficiency of follow-up visits, but also ensured the full coverage and accuracy of follow-up information collection. According to a research conducted by Royal College of Physicians, the readmission rate of treated patients drops significantly (from 15.67% to 9.24%) when attempts to contact were made. Therefore, with AI follow-up assistant, which provides more efficiency and accuracy in follow-ups, the rate readmission can be lowered even more.

Pain Points of Current Post-diagnosis Status		Value of AI Post-diagnosis Medical Solutions
The complexity of After-diagnosis management: • Chronic diseases require long-term medication, frequent re-examination and health management for control. Traditional post-diagnosis management has relied on, and even over-relied on physicians and hospitals. • However, after-diagnosis follow-up work is a constant and time-consuming process, which make it hard for physicians to manage the after-diagnosis follow-ups of a large patient population.	1 For Medical Staffs	**Reduce Workload and Improve Service Quality:** • AI can partly take over the workload of following-up which alleviates the burden on physicians, thus they will have more time for diagnosis. • Additionally, AI helps physicians to enhance the service capability and expand service scope, so as to provide full life-cycle management for patients, and accurately obtain "high value" patient group
• **Complex amount of information：** There are more than hundreds of discharges per day in hospital, and each patient is usually followed up once in 24-48 hours after surgery which will form large amount of patient information in a long term. • **Difficulties of analyzing data manually for clinical research work**	2 For Clinical and Research Work	• **Effective Data Counting ：** AI may efficiently capture information from patient responses and automatically transcribe patient speech into text then lead to statistical analysis of the massive amount of information collected. • **AI has superior analyzing capability to support clinical research work**
• **Long Queueing：** it takes forever in queue to get consultation and it costs patients a lot of time when they have questions and need to be re-diagnosed • **Patients may forget the health management for themselves.**	3 For Patients	• **Reduce Time Cost：** Patients could asking for the further consultation online for the diseases to reduce the time costing offline in queueing. • **Patients will get better health management for professional medical staffs.**

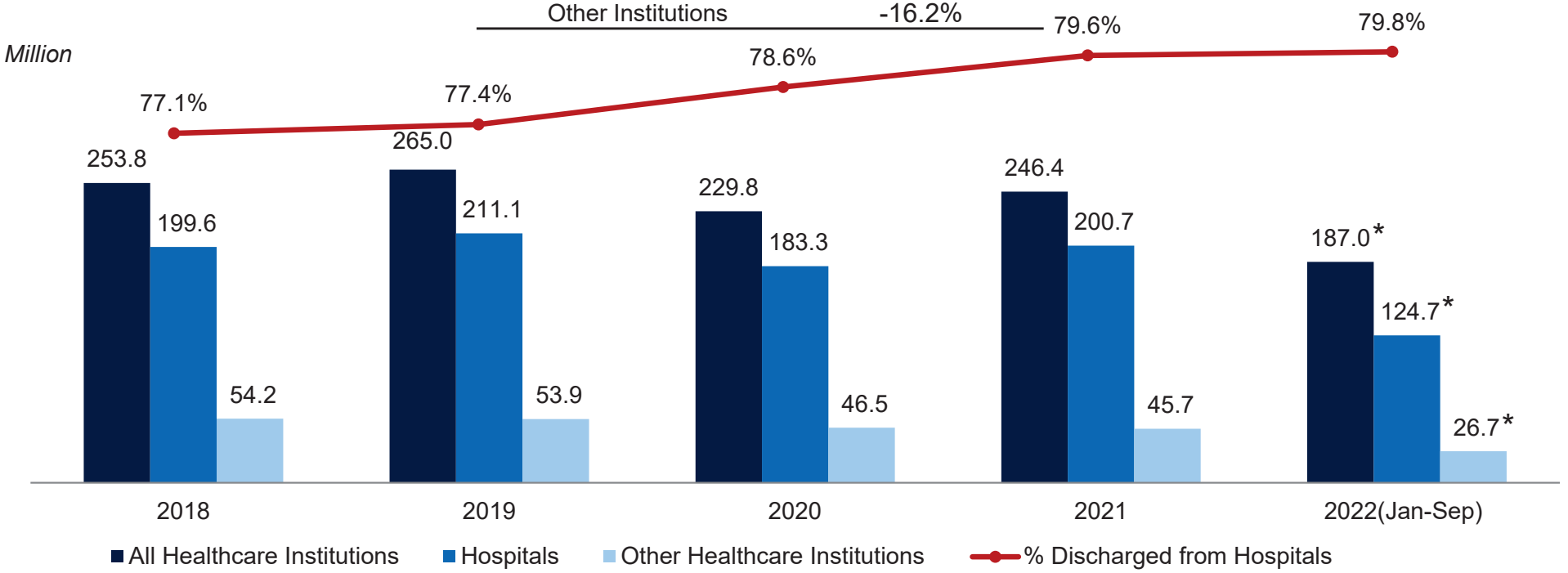
Source: Frost & Sullivan Analysis

Number of Discharged Patients of Healthcare Institutions, 2018-2022

- In 2020, the number of discharged patients from healthcare institutions dropped to 229.8 million from 265.0 million in 2019, which was mainly due to the pandemic's influence on the overall number of outpatients to healthcare institutions.
- Number of patients discharged from hospitals also experienced a decline from 2019 to 2020 due to the pandemic. Patients discharged from hospitals represent the majority of all the patients discharged from healthcare institutions.

Number of Discharged Patients of Healthcare Institutions, 2018-2022

Healthcare Institutions	CAGR
All Healthcare Institutions	-7.4%
Hospitals	-11.1%
Other Institutions	-16.2%



*All Healthcare Institutions numbers up 2.6% YoY. Hospital numbers up 2.9% YoY. Other Institutions numbers up 1.5% YoY.

Source: Frost & Sullivan Analysis

Analysis of Typical Products and Major Players of Post-diagnosis Intelligent Follow-up System in Hospitals

Manufacturer	科大讯飞 iFLYTEK | 讯飞医疗 Xunfei Healthcare	健海科技	腾讯健康
Launch Year	2016	2015	2016
Product Users	• Primary level doctors and local health commissions • Comprehensive hospitals（private, Class II III hospitals）	• Primary level doctors and local health commissions • Comprehensive hospitals	• Primary level doctors and local health commissions • Comprehensive hospitals（private, Class II, III hospitals）
Strength	• The outbound call product is backed up by AI voice recognition, natural language processing technology from Xunfei Healthcare, the leader of AI voice market. • The outbound call product can automatically record and analyze the collected data of follow-up, provide real-time feedback and long-term storage of the outbound call data.	• The AI Tracking Platform for infectious diseases can connect with their own intelligent follow-up platform, and can quickly connect with public hospital's or provincial health commission's App to realize the information sharing.	• Tencent Healthcare Intelligent follow-up is based on Tencent's strong underlying technical capabilities as technical support, and with the help of Tencent's powerful wechat ecology and cloud solution ecology, it creates an exclusive patient management platform. • Physicians had exclusive follow-up plans, access to processed patient data, and refined patient management and education. Patients received the follow-up plan and could follow the guidance to complete the follow-up and establish their own health records.
Performance/ Implementation	• During the pandemic, the health commissions and primary doctors in 30 provinces used Xunfei Healthcare outbound call service to address 67 million people, filtering out 47 thousand fever patients and 55 thousand patients with positive epidemiological history	• The follow-up system has covered 400 hospitals above Class II. • The platform has cooperated with 400 hospitals and Hainan Health Commission.	• It has worked with more than a dozen hospitals

Source: Frost & Sullivan Analysis

Overview of AI In-hospital Mobile Work Station

- Through the combination of the Internet, artificial intelligence, 5G and other technologies, AI In-hospital Mobile Work Station can realize the 360 panoramic information of patients at any time, voice medical orders are issued in time, and voice medical records are efficiently input, improving the convenience and efficiency of doctors‘ patient management. It can also provide decision support for managers through statistical analysis of operational data. And around the shift handover, ward rounds, diagnosis and treatment and other scenes, AI In-hospital Mobile Work Station meets the mobile and intelligent office needs of doctors.

Core Technology

AI Speech Engine

Core Value

In-progress Diagnosis: Patient Access

- Keep abreast of the patient's condition, support voice call to view the patient's disease information, such as medical records, doctor's orders, to improve the doctor's work efficiency.

Post-diagnosis: Mobile Rounds, Office

- Doctors can move to view 360 panoramic patient information in real time before and during room inspection, and support voice recording of room inspection process.
- Enrich doctors' mobile hospital office scenes, such as mobile consultation.

AI Assisting Ability

Core Function

Virtual Assistant

- Voice input improves efficiency
- Intelligent reminders for to-do list
- Statistical management aids decision-making

Patient Tracking

- Real-time query, telecommuting
- Information collection, quick overview
- Out-patient management

Data Management Ability

Application Process

Voice assistant	Resident doctor	Handover
360 panoramic diagram of patient		
Message board		
Retrieval of patient records	Resident doctor	Rounds
Voice rounds	Chief physician	
Voice rounds records		
Voice medical records/orders	Resident doctor	Diagnosis
Medical record coordination		

Source: Frost & Sullivan Analysis

Analysis of Typical Products and Major Players of In-hospital Interactions with Medical Personnel

Manufacturer	科大讯飞 iFLYTEK | 讯飞医疗 Xunfei Healthcare	腾讯健康 | 腾讯觅影 人工智能医学影像专家
Launch Year	2016	2016
Product Users	• Primary level doctors and local health commissions • Comprehensive hospitals（private, Class II, III hospitals）	• Primary level doctors and local health commissions • Comprehensive hospitals（private, Class II, III hospitals）
Strength	• Keep abreast of the patient's condition, support voice call to view the patient's disease information, such as medical records, doctor's orders, pathology, historical medical records, etc., to improve the doctor's work efficiency. • Doctors can use this function to view 360 panoramic information of patients in real time before and during room inspection, and support voice recording of room inspection process. Monitor important clinical indicators around the clock and alert doctors in time to effectively prevent accidents. • Rich doctors mobile hospital office scenarios, such as: voice medical records, mobile consultation, surgery scheduling, department scheduling, etc, support doctors telecommuting during the epidemic.	• Establish a smart hospital system covering the trinity of “intelligent service, intelligent medical treatment, and intelligent management", give full play to the advantages of Tencent's C-terminal, and realize the health management of a mobile phone; • Take Tencent Cloud as the base to help build a "cloud hospital"; Tencent Miying brand as the starting point, a wide range of telemedicine, medical image AI, clinical research and other services to help hospitals reduce costs and increase efficiency; • Tencent's internal cutting-edge technologies are aggregated to explore the landing practice of innovative scenarios such as meta-universe, blockchain to help the high-quality development of hospitals.
Performance/ Implementation	• The "intelligent medical assistant" has covered 30 provinces and 377 districts and counties in China, and has gradually standardized the diagnosis and treatment behaviors of primary doctors, and has assisted doctors to complete more than 180 million standardized electronic medical records.	• In the country's top 100 top three hospitals and large social medical medical group has landed a number of projects, precipitated rich delivery and operation experience, and continue to expand the layout.

Source: Frost & Sullivan Analysis

Pain Points of Healthcare Services and Future Trends of AI Application in Hospitals

- AI empowers all aspects of the hospital before, during and after diagnosis, and can improve the efficiency of hospital medical services in the state of assisting or liberating doctors. Through AI as the core of the technical means to intervene in the traditional hospital medical scenes to promote the efficiency of medical practice and medical treatment.

	Pain Points	Future Trends
AI intelligent consultation still faces many challenges such as accuracy and multi-dimensionality. Integration with electronic medical records and efficient pre-diagnosis analysis are one of the breakthroughs for future development	• The existing AI triage service is poorly targeted, mainly selected by patients according to online doctor scores and information introduction, and doctors cannot know patients' demands and key medical information in advance.	• At present, there is still a lack of high-quality clinical consultation data, and it is necessary to specifically produce clinical consultation data that meets AI training standards in order to further improve the accuracy of AI intelligent consultation. At the same time, the inquiry data combined with the analysis of the pre-diagnosis history collection system can further form a structured medical record, which can effectively help doctors to fully understand the patient's situation and improve the efficiency of face-to-face diagnosis.
Based on AI 2.0 large model technology, AI-assisted diagnosis is constantly close to the real diagnosis and treatment scene, and will gradually achieve accurate diagnosis	• On the one hand, the longest waiting period for offline diagnosis is too long, doctors in Internet hospitals are less active in online viewing and responding, and the emergency prescription needs of mild patients cannot be met; On the other hand, doctors relying too much on experience or due to time pressure may miss subtle data in medical tests or imaging results.	• Large model technology greatly improves the processing capacity of massive multi-modal data, and continuously aligns AI with real diagnosis and treatment scenarios, which is expected to eventually achieve accurate diagnosis. At the same time, auxiliary diagnosis and precision diagnosis and precision treatment are mutually driving factors, and doctors and patients will achieve more accurate matching with the help of AI.
Gradually promote the intelligent medical scene, from intelligent diagnosis and treatment to intelligent management, and build a intelligent hospital ecology	• The traditional extensive management of hospitals is inefficient and wasteful of resources, so it is urgent to transform to fine management with the assistance of intelligence.	• AI enables the intelligent diagnosis and treatment, intelligent management and intelligent service of hospitals, realizes the intelligence of medical scenes, better reduces the waste of medical resources, improves the efficiency of medical practice and medical treatment, and promotes the win-win of economic and social benefits.

Source: Frost & Sullivan Analysis

Value Analysis of Specialized CDSS in Hospitals

Assist Healthcare Personnel in Implementing Dynamic Assessment, Early Warning, and Early Intervention for Patients at Risk of VTE

- The CDSS system intelligently selects assessment items and automatically calculates scores based on the patient's diagnosis, medical prescriptions, test and examination results, and medical documents in the electronic medical record after the patient is admitted to the hospital, before and after transferring to a different department, before and after surgery, before discharge, and at the time of a change in the patient's condition.
- For patients at risk of VTE, the CDSS system will remind doctors to assess bleeding risk.
- For patients with confirmed VTE diagnosis, CDSS system recommends appropriate treatment plans for doctors, improves doctors' guideline compliance and standardizes treatment behavior.

Master the Statistics Related to VTE Prevention and Control through the VTE CDSS System to Better Realize PDCA (Plan, Do, Check, Action) Management

- The VTE CDSS management platform monitors the risk assessment rate, the number of incomplete assessments, the bleeding assessment rate, the implementation rate of prophylaxis, the implementation rate of pharmacological prophylaxis, the implementation rate of mechanical prophylaxis, etc. It reminds the doctors to take timely remedial measures for the high-risk patients who have not been prevented and treated according to the standardized prevention and control measures, which facilitates the implementation of the measures for the prevention and control of VTE, and avoids and reduces the occurrence of VTE and deaths due to the failure to prevent and treat VTE in time.

Enable Intelligent Preventive Measure Recommendations for Patients at Risk of VTE to Reduce VTE Incidence

- The VTE CDSS system can recommend appropriate basic prophylaxis, physical prophylaxis, pharmacological prophylaxis, or combined prophylaxis for healthcare professionals based on the results of the VTE risk assessment and bleeding risk assessment, and provide contraindication reminders for each type of prophylaxis.

Formation of a VTE-Specific Disease Database Facilitates Further Scientific Research

- The VTE Specialty CDSS system automatically generates specialty samples and scientific indicators for VTE research according to the rules for extracting VTE scientific indicators, accumulating more credible data for VTE clinical research.

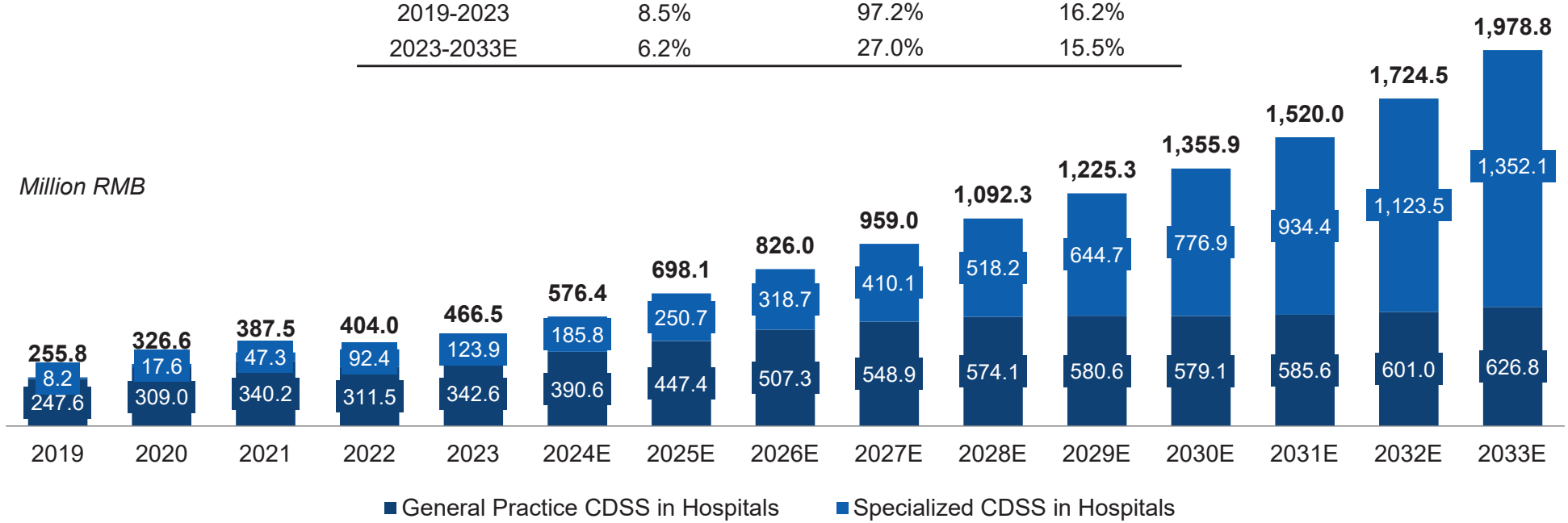
Source: Frost & Sullivan Analysis

Market Size of Hospital CDSS in China, 2019-2033E

- The specialized CDSS is primarily used in hospitals, and hospitals are also the major incremental market for specialized CDSS in the future. The market size of CDSS in Hospitals was RMB 466.5 million in 2023. The market is expected to reach to RMB 1,978.8 million in 2033, representing a CAGR of 16.2% from 2019 to 2023, 15.5% from 2023 to 2033.
- The general practice CDSS took RMB 342.6 million market size in 2023, and is expected to reach to RMB 626.8 million in 2033, representing a CAGR of 8.5% from 2019 to 2023 and of 6.2% from 2023 to 2033 respectively. The specialized CDSS took RMB 123.9 million market size in 2023, and is expected to reach to RMB 1,352.1 million in 2033, representing a CAGR of 97.2% from 2019 to 2023 and 27.0% from 2023 to 2033 separately.

Market Size of Hospital CDSS in China, 2019-2033E

Period	CAGR		
	General Practice CDSS in Hospital	Specialized CDSS in Hospital	CDSS in Hospital
2019-2023	8.5%	97.2%	16.2%
2023-2033E	6.2%	27.0%	15.5%



Note: The forecast part of data only includes the sales of existing types of CDSS, and does not predict the replacement of traditional hospital information systems by CDSS.

Source: China Health Statistical Yearbook, Public Companies' Filings, Literature Review, Frost & Sullivan Analysis

Major Players in Hospital CDSS Market in China

	Xunfei Healthcare	SYNYI AI	Goodwill Technology	HM· Dr. Mayson	Baidu Ling Yi Zhi Hui
Manufacturer	科大讯飞 iFLYTEK | 讯飞医疗 Xunfei Healthcare	森亿智能 SYNYI·AI	嘉和美康 GOODWILL	惠每科技	灵医智惠
General Practice CDSS Layout	✓	✓	✓	✓	✓
Covered Disease Areas by Specialized Version	• 1,095 common disease areas in 33 departments including: • Obstetrics • Oncology • Pan-vascular • Gastroenterology • Orthopedics • VTE • Septicemia	N/A	• ICU related diseases • Oncology • VTE	• COPD • Cardiovascular areas such as VTE	

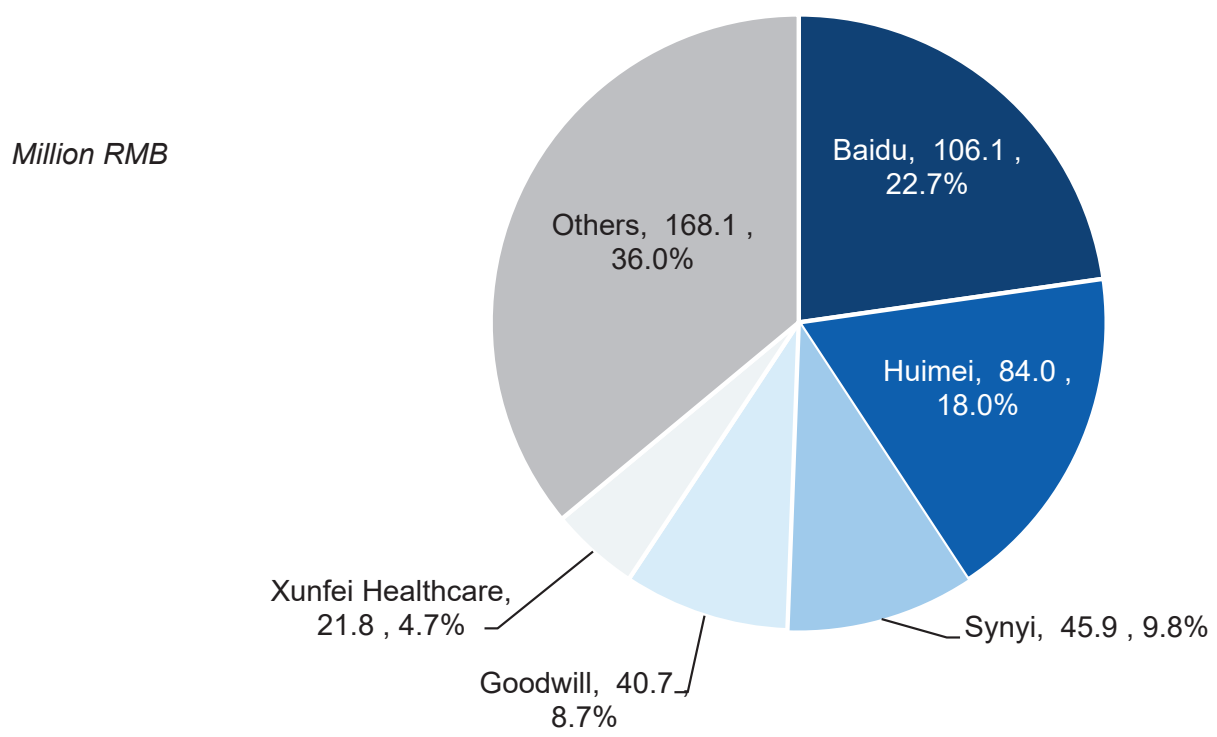
Notes: Snyni, Goodwill and Huimei also develop general practice CDSS which focus on the market of hospitals. While the future potential market growth of major players above still depends on the penetration of specialized CDSS in hospitals.

Source: Frost & Sullivan Analysis

Breakdown of China Hospital CDSS Market by Providers, 2023

- In 2023, Xunfei Healthcare ranks within Top 5 in China Hospital CDSS market with the share of 4.7%. Baidu, Huimei, Synyi, Goodwill and Xunfei Healthcare together account for 64.0% of Hospital CDSS market and the rest of players capture the share of 36.0% in 2023.

Breakdown of China Hospital CDSS Market by Providers, 2023



Source: Frost & Sullivan Analysis

Growth Drivers and Future Trends of Specialized CDSS

Various hard-to-diagnose/treat cases indicates the existing great needs for better disease management, driving the development of the specialized CDSS to promote precision medicine.	• With the aging of the population, changes in the spectrum of diseases, and the expansion of the group of elderly patients with multi-organ diseases, specialized hospitals will confront more difficult and complicated illnesses, and therefore the requirements for the business level of specialists will become more stringent, and clinical treatment urgently needs to be transformed into personalization and precision. However, the number of high-level specialists is limited, the training is difficult, and the time and economic costs are high. • The application of specialized CDSS can assist doctors in differential diagnosis and improve the accuracy of diagnosis of difficult or multiple comorbidities. Quality control management is carried out in clinical diagnosis and treatment behaviors to improve the standardization and precision of treatment links.
Specialized CDSS will develop wider disease coverage and focus on more sophisticated specialized services.	• Under the demand for the common management of multiple clinical comorbidities, the clinical decision support system has extended its functions to include data standards, clinical data platforms, biospecimen databases, intelligent assistive tools and prevention and control guidelines. At present, the specialized CDSS focuses on the management of cardiovascular diseases, and has already realized the early warning of the high-risk group of cardiovascular diseases, the enhancement of clinical diagnosis and treatment capability, and the help of hospitals to realize the "multi-disease co-management" of cardiovascular and metabolic diseases. • In the future, with the continuous progress of technology and deeper application, specialized CDSS will gradually be expanded to more specialties, such as oncology, neurology, endocrinology and other specialties that require the use of CDSS to assist doctors to provide more accurate diagnosis and treatment plans.

Source: Frost & Sullivan Analysis

Entry Barriers and Challenges of AI Application in Hospital

Trust Issues	• The majority of patients or consumers are still more willing to go public general hospitals for consultation and medical treatment due to their credibility and resources. Teams of medical experts are key to translating medical imaging knowledge into diagnostic results and outputting treatment plans. Lack of face-to-face interaction and simplified experience may decrease patient's confidence in the diagnostic results and treatment plan.
Information Barrier	• For digital healthcare services, especially online consultations, patients are required to upload their own health status data, past medical history records, and medication allergy history, which they are not good at. Patients' communication barriers to online information about relevant medical data may lead to misunderstandings and errors in doctors' consultations and treatment plans.
Limited Service Scenarios	• The nature of digital medial service sets limitation in consumer groups, by age, income, education level, and health condition. • Additionally, digital medical services are only approved for a few indications and satisfy a few patients‘ needs. • Medical imaging center relies heavily on various medical infrastructure . Small centers or new entrants are hardly equipped with a comprehensive infrastructure set and only provide limited types of services.
Insufficient and Centralized Resources	• It is difficult for a digital healthcare system to replicate the offline healthcare system model and so access to its resources is problematic. • Establishing an AI medical platform in a hospital faces a large investment in hardware equipment and personnel. In addition, even though patients can get access to experts in top-tier hospitals via digital medical service, these experts may focus more on offline patients, rather than online patients.

Source: Frost & Sullivan Analysis

Growth Drivers of AI in Hospitals

Advances in Digital Technology Drive AI Application in Hospital Healthcare Services	• In terms of digital healthcare services, technologies such as big data and artificial intelligence are also being progressively advanced to enable them to meet the technological needs for the development of digital healthcare services. For example, the development of artificial intelligence has made great strides in recent years. This advancement ensures the accuracy and quality of online prescriptions written by doctors, with AI alerting doctors when prescriptions are running low. By comparing quality with offline healthcare systems, more and more patients will be encouraged to adopt intelligent healthcare services.
Unmet Demand for Patients in Hospitals due to Misallocation of Resources and Inefficiencies in Treatment, etc.	• Tertiary hospitals, mainly in first-tier cities, have already concentrated most of China's medical resources. The main pain point of China's current healthcare system is the contradiction between the uneven distribution of healthcare resources and the growing demand for healthcare. In addition, due to the high concentration of tertiary hospitals, the quality of treatment and patient experience has declined. The overstretched healthcare system has forced the Chinese government to embrace in-hospital intelligent healthcare services by implementing several favorable policies. • On the other hand, the application of AI in non-tertiary hospitals can assist in improving the quality of healthcare services, thereby rationalizing the diversion of excessive patient visits in tertiary hospitals.
The Urgent Need for Hospitals to Control Costs under Related Policies	• In recent years, in order to curb the phenomenon of unreasonable growth in medical costs, the state has issued a series of policies on hospital cost control, and public hospital cost control is developing in the direction of "deep, detailed and strict", utilizing social power and information technology. • AI technology, by empowering hospitals in case review, clinical diagnosis, cost budgeting, medical insurance payment, etc., can greatly enhance the hospital's ability to fine-tune management, control the unreasonable growth of public hospital costs, and realize a win-win-win situation for hospitals, patients, and medical insurance.

Source: Frost & Sullivan Analysis

Future Trends of AI in Hospital in China

Initiatives to increase Operational Efficiency	• With the increasing adoption of centralized procurement of drugs, volume-based procurement, and other policies that restraints hospitals from generating revenues from drug sales, hospitals are starting to face increasing financial pressure. Such financial burden will force hospitals to focus more on increasing the hospital operational efficiency to control the cost. AI applications in hospitals can largely increase the operation efficiency of hospitals by optimizing the human and medical resources and are likely to become a top choice for hospitals to cut costs.
Solutions for Precise Match of Patients and Doctors	• As precision medicine in cancer treatment has been a hotspot for recent years, more and more medical service providers and investors started to see the value of matching the patients with the right diagnosis and treatment plan. Pairing patients with the suitable medical department is the first step of providing a precise diagnosis and treatment plan. Therefore, AI solutions such as AI triage services is gaining popularity.
Allocation of Medical Resources on Post-hospital Management	• According to a research conducted by Royal College of Physicians, the readmission rate of treated patients drops significantly (from 15.67% to 9.24%) when attempts to contact were made. A large number of patients remission can be avoided with post-hospital management. Moreover, chronic disease management has been attracting a great deal of attention as it tackles patients' drug usage compliance problem, which is one of the most difficult pain points of the current treatment system to address. In recent years, AI applications in post-hospital management will likely experience rapid growth.
Solutions to Achieve Cross-model Integration	• The current AI applications in hospitals are still fragmented. For instance, AI services aimed at the pre-diagnosis stage are not closely related to that aimed at the post-hospital stage. There are already service providers attempting to create comprehensive AI hospital solutions by integrating different business models from all stages of the medical service process into one, which helps achieve medical data interconnection through all platforms. With the interconnection of medical data, the AI applications will be able to form innovative AI medical solutions. Therefore, the cross model integration is a future trend in AI applications in hospitals.

Source: Frost & Sullivan Analysis

Table of Content

Overview of Mobile Medical Intelligent Hardware

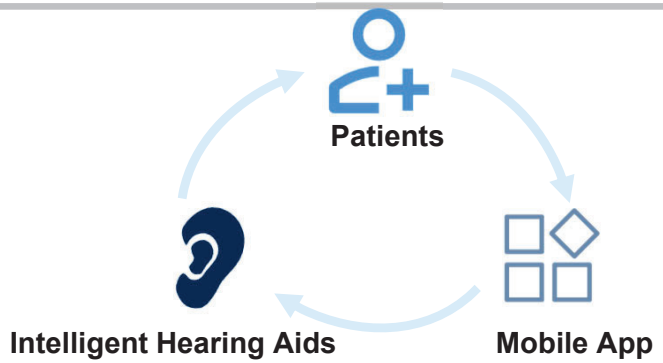
- Mobile medical intelligent hardware refers to medical products equipped with capabilities for information collection, processing, and connectivity. These products offer functions such as intelligent sensing, interaction, and big data services, serving as vital carriers for data and artificial intelligence.
- Currently, mobile medical intelligent hardware is categorized based on whether the products require medical device certification, dividing them into intelligent mobile medical devices and general intelligent mobile healthcare products. General intelligent mobile healthcare products mainly focus on monitoring non-vital sign data of users, such as body fat and weight.
- According to the "Mobile Medical Device Registration Technical Review Guidelines"(《移动医疗器械注册技术审查指导原则》) issued by NMPA, mobile medical device refers to equipment and/or software that uses non-invasive "mobile computing terminals" to achieve one or more medical purposes. The use of AI in these mobile medical device serves as a valuable solution in response to these challenges with strong technology capabilities in sensing, interaction, and big data, among others. Common AI mobile medical devices include (i) diagnostic and monitoring devices like glucometers and sphygmomanometer,(ii) assistive devices such as hearing aids, address the needs of the elderly, etc.

	Mobile Medical Devices	General Mobile Healthcare Products
Qualification	Requires Medical Device Certification	Does Not Require Class II Medical Device Certification
Product examples	 Sphygmomanometer  Thermomete  Glucometer  Fetal Doppler  Hearing Aid	 Sleep Monitoring  Intelligent Scale
Target Audience	Active Health Individuals, People with Sleep Issues, Maternal and Infant Populations, Elderly, Chronic Disease Patients, Individuals with Hearing Impairments	

Source：Frost & Sullivan Analysis

Intelligent Hearing Aid Product Overview

Specific functions of intelligent hearing aids
- Environmental Noise Reduction
- Environmental Awareness
- Voice Enhancement
- Voice Conversion



Personalized Settings
- Adjust according to individual hearing needs

APP functions and online experts
- **Intelligent** Remote Fitting
- Remote guidance and tuning

Treatment Issues and Unmet Needs of Hearing Loss

Increase in Elderly Population with Hearing Loss	• Due to organ function degeneration or underlying diseases such as metabolic and cardiovascular disorders, the probability of hearing loss in the elderly exceeds that of any other age group. Surveys show that about one-third of the elderly population suffer from varying degrees of hearing impairment. As the population ages, the number of people with hearing loss will gradually increase.
Insidious Onset	• Age-related hearing decline is a gradual and progressively worsening process, with communication barriers becoming apparent when most individuals have already reached the stage of needing hearing aids and rehabilitation.
Lack of Medical Awareness	• Many elderly with hearing loss seek professional help only 5-15 years after experiencing hearing problems, and many more do not take their hearing loss seriously, considering it a normal part of life.
High Treatment Costs	• Auditory rehabilitation for the elderly primarily involves hearing aids, cochlear implants, assistive listening devices, listening techniques, and auditory training. However, hearing aids and cochlear implants are expensive, public availability of assistive devices is limited, and there is a shortage of professionals.

Opportunities for Intelligent Hearing Aids

Intelligent Remote Fitting Function
- Convenient to use, ready to wear upon purchase

Proliferation of Smartphones
- Users can independently control and adjust the volume, scenarios, frequency bands, and noise reduction levels of their hearing aids through a mobile app.

Voice Enhancement Algorithm
- A speech enhancement algorithm was proposed to improve speech quality in a hearing aid environment by applying noise reduction algorithms with deep neural network learning based on noise classification. It brings patients a better hearing experience.

Improve patient accessibility
- Relatively low prices improve patient accessibility

Source：Frost & Sullivan Analysis

Overview of Hearing Loss

- Hearing loss is any degree of impairment of the ability to apprehend sound.
- According to the Global Burden of Disease Study, hearing loss is ranked as the fourth leading cause of disability worldwide. More than 5% of the global population, which includes 432 million adults and 34 million children, require rehabilitation to address their disabling hearing loss. It is estimated that by 2050 over 700 million people will have disabling hearing loss.

Classification of Hearing Loss

Classification	Discription
Conductive hearing loss	• Conductive hearing loss is generally caused by conditions affecting the outer or middle ear. • Conductive hearing loss is mild to moderate in severity and the medical or surgical treatment of most causes results in improvement in hearing.
Sensorineural hearing loss	• Sensorineural hearing loss is the most common type of hearing loss, caused by dysfunction in the cochlea, primarily of the sensory hair cells or the spiral ganglia neurones of the auditory nerve. • This type of hearing loss is typically not medically or surgically treatable and so its management is primarily with hearing rehabilitation using hearing aids or cochlear implants.
Mixed hearing loss	• Mixed hearing loss occurs when the patient has both conductive and sensorineural hearing loss.

Grades of Hearing Loss

Grade	Hearing threshold in better hearing ear in decibels (dB)	Hearing experience in a quiet environment for most adults	Hearing experience in a noisy environment for most adults
Normal hearing	Less than 20 dB	• No hearing problem	• No or minimal problem
Mild hearing loss	20 to < 35 dB	• No difficulty in hearing conversational speech	• May have difficulty in hearing conversational speech
Moderate hearing loss	35 to < 50 dB	• May have difficulty hearing conversational speech	• Difficulty hearing and taking part in conversation
Moderately severe hearing loss	50 to < 65 dB	• Difficulty hearing conversational speech • Can hear raised voices without difficulty	• Difficulty hearing most speech and taking part in conversation
Severe hearing loss	65 to < 80 dB	• Can not hear most conversational speech • May have difficulty hearing and understanding raised voices	• Extreme difficulty hearing speech and taking part in conversation
Profound hearing loss	80 to < 95 dB	• Extreme difficulty hearing raised voices	• Conversational speech cannot be heard
Complete or total hearing loss/deafnes	95 dB or greater	• Can not hear speech and most environmental sounds	• Cannot hear speech and most environmental sounds
Unilateral	< 20 dB in the better ear, 35 dB or greater in the worse ear	• May not have problem unless sound is near the poorer hearing ear. • May have difficulty in locating sounds	• May have difficulty hearing speech and taking part in conversation, and in locating sounds

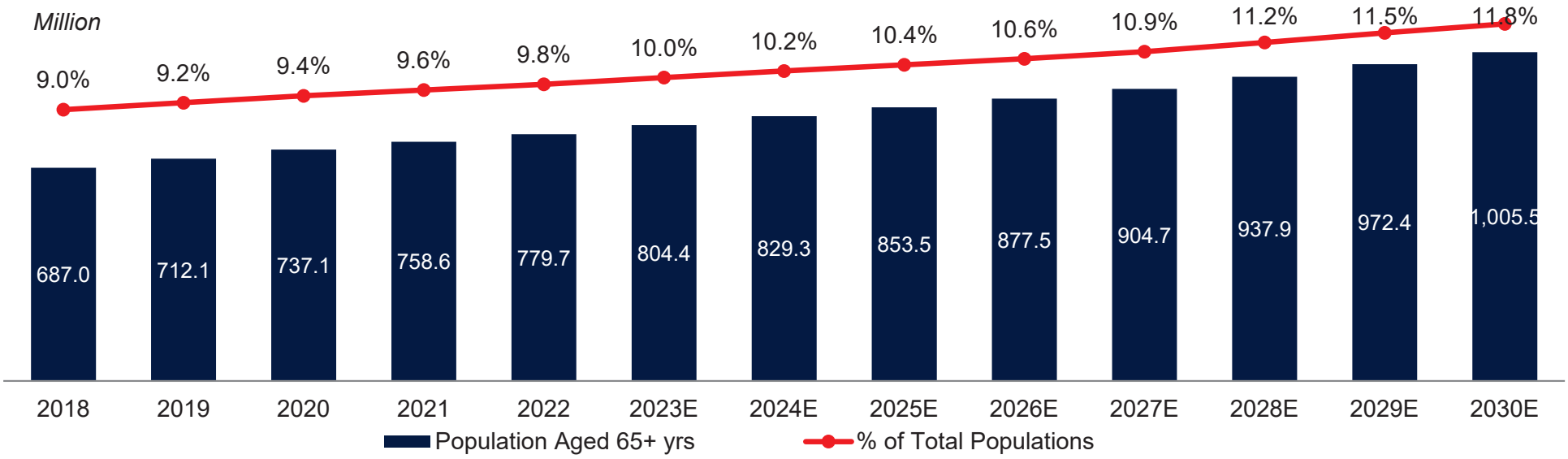
Source: Literature Review, Frost & Sullivan Analysis

Global Aging Population Trend, 2018-2030E

- Global has entered an aging society. From 2018 to 2022, the population is aging rapidly in Global with people aged above 65 growing at a CAGR of 3.2%. The number of individuals aged above 65 years old is estimated to be 779.7 million in 2022. The number of individuals aged above 65 years old is growing and is expected to continue its growth trend into the future. This number is expected to reach 1,005.5 million by 2030, representing a CAGR of 3.5% from 2026 to 2030.

Global Aging Population Trend, 2018-2030E

Period	CAGR
2018-2022	3.2%
2022-2026E	3.0%
2026E-2030E	3.5%



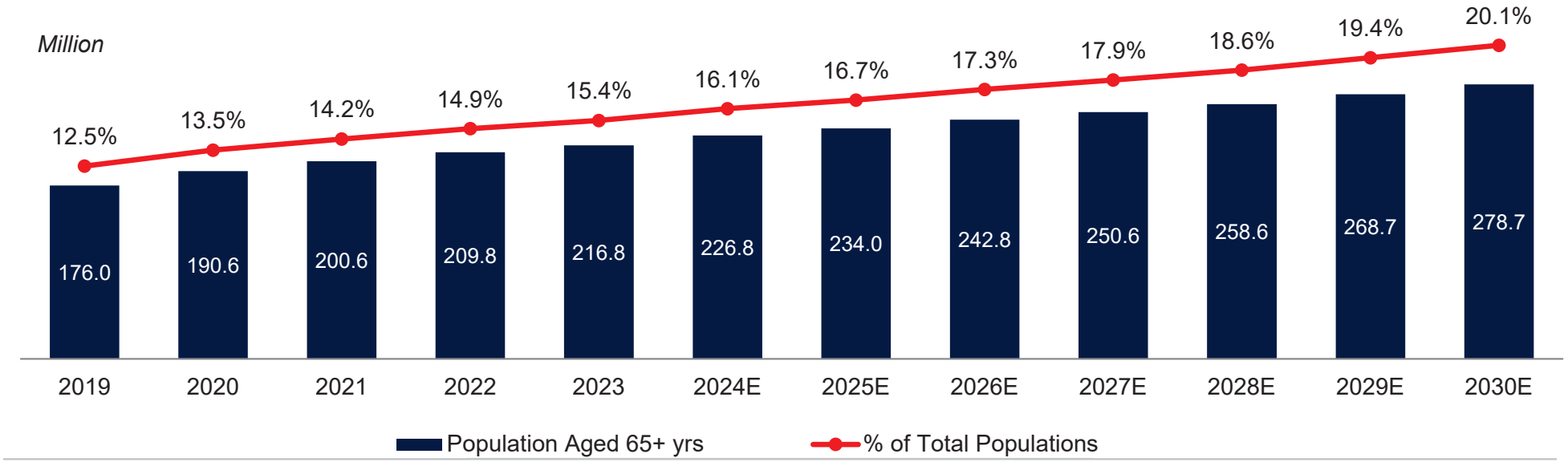
Source: Frost & Sullivan Analysis

China Aging Population Trend, 2019-2030E

- With the implementation of the 'One Child Policy' and increasing life expectancy, China has entered an aging society. From 2019 to 2023, the population is aging rapidly in China with people aged above 65 growing at a CAGR of 5.3%. According to the National Bureau of Statistics of China (NBSC), the number of individuals aged above 65 years old is estimated to be 216.8 million in 2023. The number of individuals aged above 65 years old is growing at a fairly fast pace and is expected to continue its growth momentum into the future. This number is expected to reach 278.7 million by 2030, representing a CAGR of 3.7% from 2023 to 2030.
- China's demographic shift offers immense opportunities for healthcare market, as elder people generally have a greater need for medications and scientific disease management.

China Aging Population Trend, 2019-2030E

Period	CAGR
2019-2023	5.3%
2023-2020E	3.7%



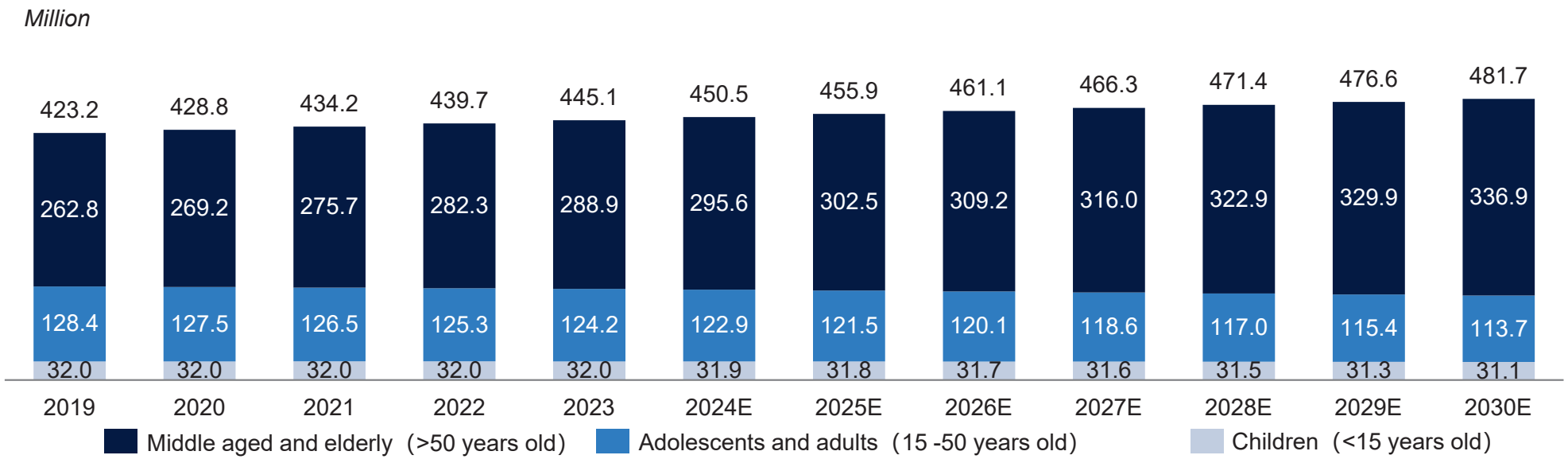
Source: NBSC, Frost & Sullivan Analysis

Number of Patients with Disabling Hearing Loss across the Globe, by Age Group, 2019-2030E

- The prevalence of disabling hearing loss (moderate degree and above) increases with age. Currently, more than 60 percent of people with disabling hearing loss in Global are middle-aged or older (people over 50 years old). As Population ageing is an irreversible global trend, this proportion is expected to continue to rise. The number of middle-aged and elderly people with disabling hearing loss is projected to grow from 288.9 million in 2023 to 336.9 million in 2030 at a CAGR of 2.4%.
- Most childhood patients with disabling hearing loss can be avoided through prenatal screening and diagnosis, etc. The proportion of childhood patients will gradually decline in the future. In 2030, the number of people in this population is expected to fall to 31.1 million.

Number of Patients with Disabling Hearing Loss in Global, by Age Group, 2019-2030E

CAGR	Middle aged and elderly	Adolescents and adults	Children	Total
2019-2023	2.4%	-0.8%	0.002%	1.3%
2023-2030E	2.2%	-1.3%	-0.4%	1.1%



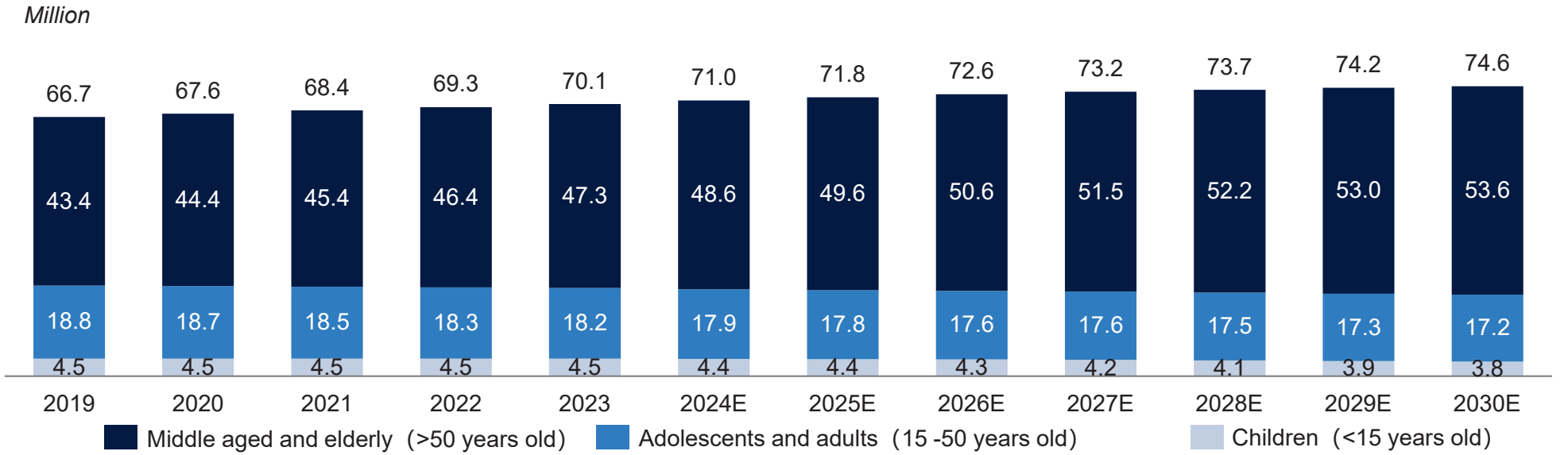
Source: Literature Review, Frost & Sullivan analysis

Number of Patients with Disabling Hearing Loss in China, by Age Group, 2019-2030E

- The prevalence of disabling hearing loss (moderate degree and above) increases with age. Currently, more than 65 percent of people with disabling hearing loss in China are middle-aged or older (people over 50 years old). As China's population ages in the future, this proportion is expected to continue to rise. The number of middle-aged and elderly people with disabling hearing loss is projected to grow from 47.3 million in 2023 to 53.6 million in 2030 at a CAGR of 1.8%.
- Most childhood patients with disabling hearing loss can be avoided through prevention, health awareness, etc. The proportion of childhood patients will gradually decline in the future. In 2030, the number of people in this population is expected to fall to 3.8 million.

Number of Patients with Disabling Hearing Loss in China, by Age Group, 2019-2030E

CAGR	Middle aged and elderly	Adolescents and adults	Children	Total
2019-2023	2.2%	-0.9%	-0.01%	1.2%
2023-2030E	1.8%	-0.8%	-2.6%	0.9%



Source: Literature Review, Frost & Sullivan analysis

Entry Barriers of Artificial Intelligent Hearing Aids Industry

The Cost of the Chip	• The quality of chip processing capacity is the core component of intelligent hearing aids, as noise reduction, remote fitting functions, wireless technology, etc. are all carried on this small chip. Chips with stable quality and excellent performance are essential for enterprises to achieve product iteration and upgrade, rapid innovation, and cost reduction. However, most domestic manufacturers still rely on imported chips, resulting in high production costs, and only a few manufacturers can self-developed chips or cooperate with domestic chip manufacturers.
Digital Signal Processing Algorithms	• The performance of hearing aids not only depends on hardware, but also relies on the quality of digital signal processing algorithms. These algorithms are pivotal in shaping the sound quality of the hearing aids, ensuring that patients can hear clearly, and comfortably within their audible range. • Complex hearing aid algorithms are needed during the development of hearing aids. Firstly, it is necessary to improve speech recognition in noise through algorithms in a noisy environment. In this case, the noise classification algorithm is needed for different noise situations, so as to improve the applicability of digital hearing aids. This process requires a combination of multiple disciplines such as signal processing, audio codec, and machine learning, as well as a lot of detailed optimization in combination with the hardware platform. Secondly, remote fitting also requires complex algorithms and signal processing. Therefore, the implementation of these functions requires strong algorithm development support, as well as corresponding talents.
Consumer Education	• Over 90% of the hearing aid market in China is controlled by foreign industry leaders like Phonak, Oticon, Widex, ReSound, and Starkey, leaving just 10% for domestic small and medium-sized enterprises. These foreign brands entered the market early and conducted distributor and user education ahead of schedule. Consumers tend to favor expensive imported products, posing a challenge for domestic brands in educating consumers and necessitating a prolonged market penetration effort.

Source：Frost & Sullivan Analysis

Growth Drivers of Artificial Intelligent Hearing Aids Industry

Increasing Prevalence	• The rising prevalence of hearing loss is a key factor increasing the demand for intelligent hearing aids. According to “Analysis of global and Chinese disease burden of hearing loss from 1990 to 2019”, the number of people with hearing loss worldwide increased from 752 million to 1.457 billion from 1990 to 2019, with an increase rate of 93.75%. During the same period, the number of people with hearing loss in China increased from 199 million to 407 million, with an increased rate of 104.52%, which was higher than the global level. • The growing geriatric population is also another factor contributing to the rising prevalence of hearing loss. The "China Hearing Health Report (2021)" indicates that the prevalence of hearing impairment rises with age, and it is projected that by 2030, the proportion of the elderly population in patients with hearing loss will surpass 60%.
Improper Use of Personal Audio Devices or High Volume Exposure	• WHO estimates that 1.1 billion young people worldwide could be at risk of hearing loss due to unsafe listening practices. Nearly half of all teenagers and young adults (12 to 35 years old) in middle- and high-income countries are exposed to unsafe levels of sound from the use of personal audio devices, or exposed to potentially damaging sound levels at clubs, and bars. The increased inappropriate use of personal audio devices and exposure to high volume over a long period, increase the demand for intelligent hearing aids for young people.
The Younger Generations concern for their Parents	• As the improvement of education level, the healthcare attitudes of younger generations are gradually evolving, leading to increasing attention on the care of the elderly. The "China Elderly Health and Family Well-being Impact Factors Tracking Survey (2021)" issued by the China Population and Development Research Center reveals that 80% of the elderly receive daily care from family members, with half of it provided by their sons and daughters-in-law. The satisfaction of the elderly is high, and their younger generations demonstrate a strong sense of filial piety. Consequently, younger generations are increasingly inclined to assist their parents in selecting appropriate hearing aids, thereby fueling the growing demand for artificial intelligent hearing aids in the market.

Source：Frost & Sullivan Analysis

Future Trends of Artificial Intelligent Hearing Aids Industry

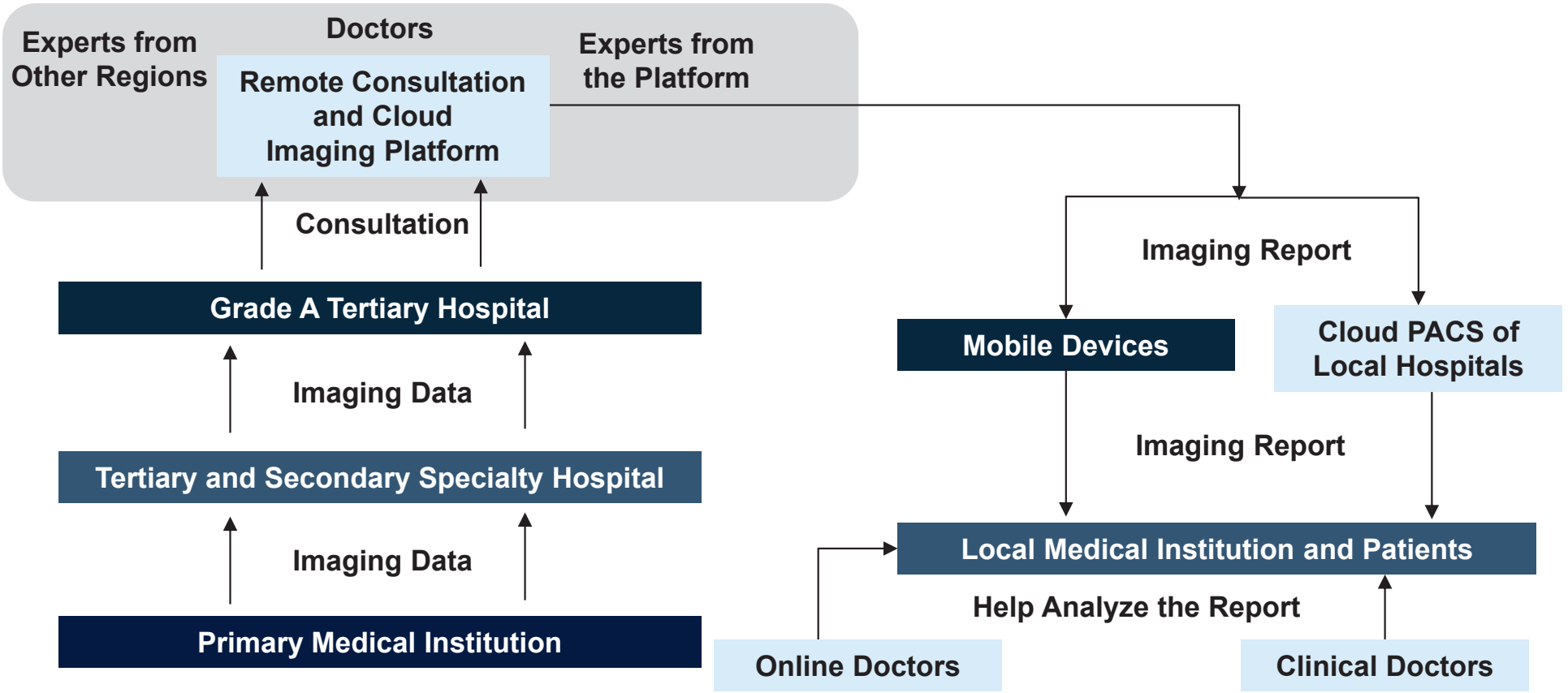
Broad Overseas Market	• To increase public access to hearing aids and improve hearing, the FDA established a new category of over-the-counter hearing aids for adults 18 years of age and older with perceived mild to moderate hearing loss, which went into effect on October 17, 2022. This step not only makes it more convenient for individuals with hearing loss to purchase hearing products, but also provides opportunities for more manufacturers by reducing the sales channel threshold, thus creating a broad overseas market for relatively affordable domestically produced intelligent hearing aids. In the future, as the core components, including chips for hearing aids, become localized and further substitution for imported hardware, the competitiveness of domestic artificial intelligent hearing aids in international markets will be further strengthened.
Standardization of Management	• Hearing aid products belong to the medical device industry, which regulatory system is relatively strict, with strict management systems established for product registration, production, and distribution. However, there is currently a lack of regulations for over-the-counter hearing aids in China. In the future, If the National Medical Products Administration could refer to the U.S. Food and Drug Administration's addition of an OTC hearing aid category and establish different regulations for their access and sales compared to traditional hearing aids, it would effectively stimulate the manufacturing and sales of intelligent hearing aids.
Personalized Service	• With the application of big data and cloud computing, many hearing aid manufacturers are beginning to provide personalized services based on individual hearing conditions and preferences. For example, wireless technology enables remote fitting services to transmit data between smartphones and hearing aids through a remote service platform and big data system. This allows audiologists to adjust the devices remotely, providing patients with a more convenient and efficient fitting solution. Additionally, the user information and data obtained through remote fitting can be used to establish personalized health records, enabling the monitoring of users' hearing health, equipment maintenance.

Source：Frost & Sullivan Analysis

Table of Content

Overview of Cloud Imaging Platform

- Cloud imaging platform builds up a bridge between patients, hospitals, doctor groups by using artificial intelligence technologies. It not only creates new solutions for medical treatments and utilizes medical resources more efficiently but also enables the interconnection of imaging between regional primary medical institutions and large hospitals.



Source: Frost & Sullivan Analysis

Value Analysis of Remote Consultation and Cloud Imaging Platform

Values of Remote Consultation and Cloud Imaging

Artificial Intelligence Assisted Diagnosis

- It uses artificial intelligence to sort and analyze fragmented medical information to provide assistance in the medical diagnosis process.

Intelligent Image Reading Terminal

- Experts can access, collaborate, and analyze the data at any time and anywhere as long as internet is available.

Three Dimensional Remodeling

- It uses multi-terminal reconstruction including PC end, mobile end, and platform end to realize separated remodeling.

Synchronization

- It allows for clients to sign in from different terminals at the same time and provides a platform for interaction.

Values For Medical Institutions at All Levels

Pain Points

- Many local medical institutions lack experienced doctor groups due to the limited medical resources.
- The doctors in the primary medical institutions have limited tools to analyze imaging data of patients with a variety of diseases.

Medical Institutions at all Levels

- Using remote platform functions such as the imaging cloud platform, cloud film, artificial intelligence diagnosis, etc., the imaging data can be uploaded to the cloud, and doctors can seamlessly and remotely retrieve the data.
- The intelligent diagnosis module embedded in the platform can be used to help the doctors of the primary medical institutions quickly make clinical diagnoses.

Values For Patients in Medically Less Advanced Areas

Pain Points

- Patients have limited access to advanced medical facilities at local primary medical institutions.
- The diagnosis process could be inefficient due to the limited knowledge of the local doctor groups, which could delay their treatment.

Patients in Medically Less Advanced Areas

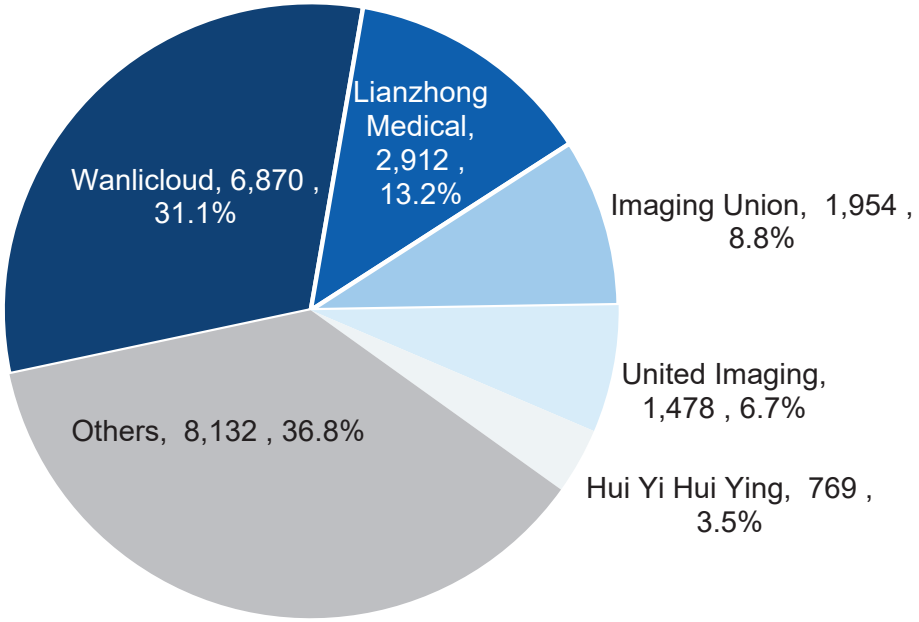
- Improve the accuracy of image diagnosis for grassroots doctors through AI assistance and provide patients with a better consultation experience.
- Remote experts can quickly retrieve the imaging sample reports required for a single disease from the imaging database, and the platform can provide data sorting and screening services, increasing the efficiency of the diagnosis process.

Source: Frost & Sullivan Analysis

Breakdown of China Cloud Imaging Market by Providers, 2023

- In 2023, Imaging Union covers 1,954 healthcare institutions with a market share of 8.8%, ranking the Top 3 among all China cloud imaging players.
- Wanlicloud, Lianzhong Medical, Imaging Union, United Imaging and Hui Yi Hui Ying account for 63.2% of the China Cloud Imaging market and the rest of players capture the share of 36.8% in 2023.

Breakdown of China Cloud Imaging Market by Providers, 2023



Source: Frost & Sullivan Analysis

Growth Drivers and Trends of Cloud Imaging Platform in China

Aging Population	• The aging population has greatly increased the demand for healthcare protection and the demand for medical imaging data services. Reinvestment in healthcare resources due to population aging will be a long-term market opportunity.
Government Policies Support	• Relevant national departments have successively issued a series of policies related to the medical industry, in which medical imaging data services are regarded as a key development area. • The Opinions on Promoting the Development of "Internet + Healthcare" mentioned the integration, sharing and application of clinical and scientific research data to improve the digitization of medical and healthcare equipment. The Measures for the Management of Healthcare Consortiums introduced in 2020 required hospitals within a medical consortium, together with public health organizations, to guide primary health-care institutions in implementing public health functions and to work together on disease prevention, health management and health education, which had led to a growth in demand from hospitals and patients for inter-hospital data-sharing and exchange.
Low Penetration Benefit and Rapid Expansion of Third-party Medical Imaging Centers	• Currently domestic medical imaging data service market is in the growth period of rapid development with low market saturation, which main driving force for growth is the continuous improvement of penetration. • The demand for medical imaging tests has surged in recent years due to the impact of the pandemic on people. The workload of imaging tests in medical institutions everywhere has risen steeply, with imaging physicians showing the rapid expansion of a series of third-party medical imaging centers.
Rapid Development of Technology Advancement	• The continuous enrichment of imaging technology has transformed medical imaging from an auxiliary examination method to the most important clinical diagnosis and differential diagnosis method. More advanced and convenient imaging diagnostic equipment will make clinical diagnosis and treatment more dependent on imaging examinations, which will increase the demand for medical imaging data service and promote the development of medical imaging data service market in a cycle.
Teleconsultation Needs of primary healthcare institutions	• Primary medical institutions lack advanced imaging equipment, and the number of radiologists is insufficient, the level is limited, the diagnostic ability is difficult to support the clinical diagnosis demand, remote consultation demand is urgent.AI imaging platform can provide remote imaging consultation services, improve the diagnosis and treatment level of primary medical institutions.

Source: Frost & Sullivan Analysis

Market Potential Analysis of Information System in Healthcare Institutions in China (1/2)

Class III hospitals market potential

China's Class III hospitals market potential analysis	=	A Number of Class III hospitals in 2022 in China **3,523**	×	B Potential value of information system in Class III hospitals **RMB 60.0 Million**	=	**RMB 211.4 Billion**

Class II hospitals market potential

China's Class II hospitals market potential analysis	=	A Number of Class II hospitals in 2022 in China **11,145**	×	B Potential value of information system in Class II hospitals **RMB 20.0 Million**	=	**RMB 222.9 Billion**

Class I and unclassified hospitals market potential

China's Class I and unclassified hospitals market potential analysis	=	A Number of Class I and unclassified hospitals in 2022 in China **22,308**	×	B Potential value of information system in Class I and unclassified hospitals **RMB 50.0 Million**	=	**RMB 1,115.4 Billion**

Notes:
A: number of classified healthcare institutions in 2022
B: assumed market value of information system in healthcare institutions

Sources: Frost & Sullivan Analysis

Market Potential Analysis of Information System in Healthcare Institutions in China (2/2)

Primary healthcare institutions market potential

China's PHC institutions market potential analysis	=	A Number of PHC institutions by county in 2022 **2,843**	×	B Potential value of information system in PHC institutions **RMB 30.0 Million**	=	**RMB 85.3 Billion**

Healthcare institutions market potential

Overall market potential of information system in healthcare institutions	=	Class III hospitals market potential **RMB 211.4 Billion**	+	Class II hospitals market potential **RMB 222.9 Billion**	+	Class I and unclassified hospitals market potential **RMB 1,115.4 Billion**	+	PHC institutions market potential **RMB 85.3 Billion**	=	**RMB 1,635.0 Billion**

Notes:
A: number of PHC institutions by administrative unit of county in 2022
B: assumed market value of information system in healthcare institutions

Sources: Frost & Sullivan Analysis

F&S to Confirm

- The company ranked first in the healthcare AI industry in terms of revenue in China in 2022.
- The Company is one of the first market participants in advancing and implementing the Large Language Model ("LLM") in the healthcare industry in China.
- The company was the only corporate participant in the development of the "Technical Evaluation System and the Standard Specifications of LLMs for Use in Healthcare". This is one of the first industry standards setting the rules for the use of relevant healthcare AI technologies in China to comprehensively assess the use of AI technologies in the healthcare industry.
- The company's hearing aids ranked first in terms of sales revenue in the same product categories during the "618 sales", in 2023 on both JD.com and Tmall.
- The company's General Practice CDSS, the first and only machine in the world that passed the NMLE (General Written test) as of Dec 9th,2023, ranked first in terms of revenue with a market share of 76.6% in China's primary healthcare institution CDSS market in 2022.
- In 2017, the underlying AI model passed the NMLE (General Written test).
- LLMs are expected to promote global economic growth in the near term, with domain-specific LLMs offering notable market opportunities in specific and complex industries, including healthcare.
- As a subsidiary of iFlytek Group, the leader of AI and speech technology in China, the company aims to become a global leader in healthcare AI.
- The company's Cloud Medical Imaging Platform is the largest cloud-based medical imaging platform in Anhui province in terms of the number of healthcare institutions covered.
- The lack of domain-specific knowledge in general LLMs hinders their ability to interpret technical terms and produce accurate, rational responses when utilized in healthcare for the benefit of patients and practitioners.
- The accuracy rate of company's Medical AI speech recognition is 96%, surpassing most industry players.
- It is industry practice for the end user to engage intermediaries which provide different types of assistance in project implementation, such as advising on selecting suppliers, managing construction and integrating the work products if different services are selected, and the decisions as to which supplier to choose are primarily made by end users.
- In 2022, the number of people with COPD and asthma in China reaches about 106.4 and 67.3 million respectively.
- In 2022, total cancer incidence has reached 4.8 million in China.

Source: Frost & Sullivan Analysis

F&S to Confirm

- The market potential for AI applications in healthcare institutions is huge as the total annual spending on information systems by healthcare institutions in China exceeds 100 billion RMB.
- The purchase pattern within the healthcare AI industry, especially that of healthcare administrators and hospitals, is expected to shift from large one-off purchases for the initial implementation of projects to ongoing project maintenance and operations as well as additional add-on services.
- The key entry barriers in the healthcare AI industry include industry insight barrier, financial resources, inter-disciplinary talent and regulatory requirements.
- As the healthcare AI industry is still in its nascent stage, it is common for market participants in the healthcare AI industry to incur losses as they invest heavily in technology development characterized by significant upfront investment in research and development.
- The size of markets in developed regions are typically larger compared to those in underdeveloped regions because there are more healthcare institutions, higher budgets for relevant investment and more diverse demands for AI healthcare services, such as those from hospitals and patients.
- The COVID-19 pandemic has promoted heightened awareness of preventing and monitoring infectious disease and created market potentials for AI healthcare products and services for the regional healthcare administrators to better track, monitor and respond to potential outbreak of infectious diseases.
- The pricing basis of the company's products and services are in line with industry average.
- The development and launching of new healthcare AI products are inherently time-consuming due to (a) the novelty of the technology and its applications and (b) the stringent regulatory requirement in the healthcare industry.
- The addressable markets in different regions vary with factors such as GDP of different regions.
- The services provided by iFlytek Group to the company are ancillary in nature and/or readily available from an Independent Third Party in the market.
- Such model and resources of iFlytek Group (like Xunfei Spark Medical Model) are general in nature and are readily available on the market.
- The company's customers usually adopt a centralized procurement system, with the annual budget and procurement plan formulated at the beginning of each year, followed by tendering process starting from the second quarter of the year and concluded with acceptance tests completed in the fourth quarter of the year.

Source: Frost & Sullivan Analysis

F&S to Confirm

- The company's credit period, trade receivable turnover days and bill payables turnover days are in line with industry practice.
- The healthcare AI market in China is fragmented with hundreds of regional players, and there will be sufficient potential targets that meet our criteria for acquisition.
- The heightened awareness among the public has driven the demands for value-added services such as personalized and refined solutions, where patients receive care that can be tailored to meet their unique needs.
- It is common for market participants in AI or healthcare AI industries to incur losses in their early development stage as they invest heavily in technology development characterized by significant upfront investment in research and development.
- The pricing basis of the Company's projects is in line with industry practice.
- Medical reasoning is an advanced technology of AI application in healthcare. The technology builds a medical cognitive reasoning technology framework based on AI, utilizing deep learning algorithms to cover key issues in the entire process of diagnosis and treatment, such as intelligent guidance and triage in pre-diagnosis phase, diagnostics and inquiry assistance, and quality control of medical records. The advancement and complexity of this technology is reflected in (i) the diversity and depth of application scenarios, and (ii) the precise fulfillment of the actual needs of the healthcare industry and the prospective solution of potential problems. Natural Language Processing ("NLP") is also one of the key technologies empowering AI in healthcare. The technology accumulates data during system operation and uses deep learning techniques to obtain accurate interpretations from extensive, unstructured and unlabeled text and speech datasets, transforming them into structured healthcare data for AI models, demonstrating its sophistication and complexity in processing and integrating information from different modalities.
- Defining features of SaaS companies include (i) cloud-based services that allow customers to access and use services over the Internet, eliminating the need for local installation or maintenance; (ii) subscription-based business model with clients paying a recurring fee to use the software, which ensures they always have access to the latest updates and features without additional costs; (iii) high scalability allowing for flexible user numbers.
- There are plenty of alternative chip suppliers, including those from PRC in the AI industry.

F&S to Confirm

- The Company's credit period, trade receivable turnover days and payment terms of projects related to long-term trade receivables are in line with industry practice. Regional healthcare administrators or companies established by regional governments tend to have extended payment terms for their internal financial management and payment approval procedures. Service providers such as the Company need to agree to such terms to maintain long-term business partnerships with these entities.
- According to Frost & Sullivan, the government will promote the implementation of AI healthcare products in PHC institutions such as general CDSS and phone call robot.
- According to 《2023中國衛生健康事業發展統計公報》, there are 3,855 Class III hospitals in China in 2023, accounting for 10.1% of all hospitals, but they are responsible for more than 2,600 million visits, accounting for 61.7% of the total number of hospital visits in 2023.
- As of Dec 9th, 2023, there were more than 30 major active players in the CDSS market in China.