Surging Industry Vitality

Originated from China's Biomedical City Innovation Map

——China Biomedicine City Innovation Index in Post-epidemic Era (CBCII)

CONTENTS

1. Introduction

Plastics will be completely replaced by corn rather than using petroleum as raw materials. Construction materials will be replaced by fiber crops such as kenaf. The depletion of petroleum will no longer be terrible because it can be completely replaced by the straw. Human life may reach 120 years old by 2050. 500 million mu of barren land and saline-alkali land will become a paradise for plant growth. They are not fanciful because many have already been realized or are about to be realized. All this heralds that a revolution that will change human life and production methods is coming and the process of this revolution is far beyond people's imagination! This is the fourth technological revolution focusing on biotechnology since the 1990s. Some experts have predicted that, following the "hunting economy", "agricultural economy", "industrial economy" and "network economy", the fifth economic form of humankind will be "bio-economy".

This is a century in which biomedical science can change the ideal of human healthy life. Considering the progress of the past few years, the breakthroughs in cancer immunotherapy has achieved amazing transformations in patients who are dying. Pre-exposure HIV prevention has shown to be almost 100 per cent effective in preventing the spread of the disease. Revolutionary gene editing techniques are challenging the foundation of congenital diseases, and stem cell research is delivering some of its first products to market.

Globally, more than $240 billion is spent on health research and development each year. Although declining in the field of biomedical funding and high-quality research results, the United States is still a global leader in both fields. From 2012 to 2018, China's high-quality biomedical scientific research output (calculated by the natural index score) increased by 141.2%, exceeding the moderate growth of other countries. Researchers predict that China’s funding will surpass that of the United States in 2022.

At present, there is still a gap between the innovation of China's bio-medicine industry and that of the world in terms of the number of new drugs in different therapeutic fields and the participation degree of top innovative drugs in the world. Also, from the point of development of China's healthcare industry, to achieve biomedical innovation power of vision, our biomedical industry must start from the existing” repetitive, decentralized, low-value-added, and domestic low-level competition” of various provinces and cities. Then, we need to build industry innovation endogenous force focusing on developed cities, form differentiated cooperation at regional and national level and jointly promote the development of my country’s bio-pharmaceutical industry towards "characteristic, concentrated, high value-added, and international market competition".

2. Look at global biomedical industry

2.1 Global biomedical industry trend

With the rapid development of global biomedical technology, people pay more and more attention to life and health. Driven by technological progress and demand growth, as well as the increasing investment of governments in the field of medical and health care, the growth rate of the biomedical and health industry is higher than the overall economic development level worldwide. According to “The Global Use of Medicine in 2019 and Outlook to 2023” issued by IQVIA, the global medical expenditure in 2018 reached 1.2 trillion dollars. By 2023, the global pharmaceutical market will exceed 1.5 trillion US dollars, and it will grow at a compound annual growth rate of 3-6% in the next five years. Although the growth rate of the global bio-pharmaceutical industry has slowed significantly compared to the past five years, it is still higher than the IMF's global economic growth rate forecast, fully demonstrating that the overall growth trend of the global pharmaceutical market is strong and the biomedical industry is rapidly developing from the most promising high-tech industry to a high-tech pillar industry.

The increasing integration of technology and healthcare will provide new opportunities for the global biomedical industry. The use of real-world evidence to measure the actual performance of drugs after approval and to drive future investment decisions. Machine learning technology is used not only to accelerate drug discovery, but also to drug development, with the hope that a data-driven approach will help reduce R&D costs and industry failure rates. Whole-genome sequencing and wearable technology have brought the medical industry into a new medical era.

From the perspective of market size and compound growth in the global prescription drug and non-prescription drug, the top 10 therapeutic areas of global pharmaceutical manufacturing are respectively tumor treatment, anti-diabetics, rheumatism, vaccines, anti-virus, immunosuppressive agents, bronchodilators, dermatological drugs, sensory organs and anti-hypertensive drugs according to Pharmaceutical statistics. Since the 1990s, global sales of biological drugs have been growing at an annual rate of more than 30%, much higher than the annual growth rate of less than 10% in the global pharmaceutical industry. There are more than 2,200 bio-tech drugs under development in the world, of which more than 1,700 have entered clinical trials. The rapid increase in the number of biotechnological drugs indicates that the industrialization of the world's medical biotechnology in the 21st century is gradually entering the investment harvest period, and the global biomedical industry is growing rapidly.

At present, the global drug development pipeline has the following trends and characteristics. Although the growth rate has declined, the overall number of R&D pipelines has maintained growth. The number of new drugs in the clinical stage and the success rate have not changed significantly. The proportion of the top ten drug R&D companies in the new pipeline has declined, and more small companies with the small number of pipelines occupy the share of the new pipeline. The research and development pipeline of anti-cancer drugs accounts for 1/3 of the total, and still maintains a fast-rising trend. The research and development of cancer immunotherapy-related drugs is not diminishing. Biological drugs account for 40% of all new drugs under development.

The "valley of death" between academic research and R&D in business has always been an

important obstacle preventing university laboratories from bringing their research results to the market. Taking the United States as an example. From their experience, this obstacle will be solved through innovation research institutes and accelerators.

2.1 Driving forces of global biomedical industry

2.1.1 Demand growth

The aging of the global population and the rising prevalence of serious diseases such as cancer and chronic diseases have led to increasing demand for disease treatment. According to the data from the "World Population Outlook: 2019 Revised Edition", one in six people in the world will be 65 or older (16%) in 2050, compared with 11 (9%) in 2019. By 2050, one in four people in Europe and North America will be 65 or older. In 2018, the number of people 65 years of age or older in the world exceeded the number of people under 5 years old unprecedentedly. In addition, the number of people aged 80 or over is expected to triple from 143 million in 2019 to 426 million in 2050, with the global population aged 65 and over growing faster than the younger age group.

The International Agency for Research on Cancer (IARC) under the World Health Organization's 2018 global cancer statistics "Global Cancer Report" provides relevant data on the incidence and mortality of 36 cancers in 185 countries and regions around the world. The report shows that in 2018, there were 18.1 million new cancer cases worldwide and 9.6 million deaths. The global cancer burden has further increased. By 2040, the global cancer burden will reach 27.5 million new cases and 16.3 million deaths. The task of preventing and treating cancer is a long and arduous one.

2.1.2 Advanced technology

Biological and medical research breakthroughs have promoted people's understanding of disease mechanisms and brought innovations in treatment, intervention and control methods. For example, the cost of gene sequencing technology is reduced, and the detection speed is faster, which provides basic technical support for basic research on disease biological processes and clinical medication. The gene recombination technology represented by CRISPR provides an important tool for basic research, thus promoting the discovery of new mechanisms and new targets. The repair of stem cell technology and the breakthrough in stimulating the body's regenerative function bring hope to the nervous system diseases that were difficult to treat in the past.

The extensive integration of interdisciplinary subjects and medical and health research accelerates the technological progress of the medical and health industry and the updating of business model. The extensive integration of cross-discipline and medical and health research has accelerated the technological progress of the medical and health industry and the update of business models. Information technology represented by big data, cloud computing, and the Internet of Things has brought information and intelligence throughout the entire process of disease prevention, diagnosis, and treatment, thereby improving the quality of interaction between doctors & patients and bringing about more reasonable allocation of medical resources.

The integration of material science and the medical and health industry has led to the introduction of advanced material technology, such as 3D printing technology, carbon fiber materials and nanomaterials, into high-performance consumables and medical devices, such as

wearable devices.

Based on the accumulation of a large amount of experimental data and clinical electronic medical records, artificial intelligence has gradually begun to show good performance and broad application prospects in the fields of medical imaging assisted diagnosis, drug development assistance, and health management.

2.1.3 Policy Support

For the bio-medicine and medical industry, the future policy direction is one of the important factors affecting the progress of the industry, and it will also directly affect the R&D and development direction of enterprises and technologies in various subdivisions. Many countries regard the biotechnology industry as a strategic industry to be given priority for development in the 21st century and an important means to improve their national competitiveness. They have formulated development plans, strengthened leadership, recruited talents, and increased policy support and capital investment for the biomedical industry.

The United States regarded the biomedical industry as a new economic growth point, implements the "Biotechnology Industry Incentive Policy", and continues to increase its investment in biotechnology R&D and industrialization. Japan formulated the "Bio-Industry Building" strategy. The sixth Framework for Scientific and Technological Development of the EU devotes 45% of its research and development funds to biotechnology and related fields. The British government set up the Biotechnology Coordinating Steering Committee as early as 1981 and took measures to encourage industrial universities and research institutions to increase investment in biotechnology development and research. Singapore formulated a “Ranking among the top bio-technologies in five years” plan, and will allocate 3 billion dollars within 5 years to fund the life sciences and biotechnology industries. India established the Ministry of Biotechnology, which invests between 60 and 70 million dollars annually for biotechnology and medical research. In the 1990s, when Cuba’s economy was very difficult, it implemented the “Biotechnology Investment Plan” and invested 1 billion dollars to develop the biotechnology industry. Over the past 10 years, more than 400 patents have been obtained and biomedical products have been exported to more than 20 countries including the United Kingdom, which directly promoted the prosperity of the Cuban economy.

2.1.4 Covid-19 vaccine and treatment

In the first half of 2020, the corona-virus pandemic is the driving force affecting the bio-pharmaceutical and medical technology industries. The speed of the recovery in financial markets comes as the scale of the COVID-19 outbreak becomes clear. Most global indexes are well on their way to a full recovery, led by health-care stocks. The NASDAQ Biotechnology Index has reached a new high in April and investors have rushed to support industries that have pledged to provide vaccines and treatments for COVID-19. Gilead's antiviral drug remdesivir has received emergency approval, and more projects are under development. The Covid-19 diagnostic system was quickly introduced to the market, and industry leaders like Abbott and Roche were also rewarded for their efforts. Virus test will help develop vaccines and treatments, linking the fate of drug and diagnostic developers.

2.2 Global biomedical industry challenges

Solving the problem of antibiotic resistance is one of the most pressing challenges in biomedical research. Resistance to tuberculosis drugs is a “huge obstacle” to the fight against the disease that kills 1.6 million people every year. However, few large pharmaceutical companies invest in antibiotics, and many large companies withdrew from efforts to find new antibiotics, which means that most of the early R&D was done by smaller bio-tech companies.

Cell and gene therapies have proven to be attractive targets. American bio-tech giants Amgen and the University of Iceland are collaborating with scholars from the University of Iceland to conduct a genome-wide association study. The study aims to investigate whether there are small genetic variants in the human genome that may indicate a higher risk of certain diseases.

Although cancer and heart disease are the biggest killers in high-income countries, the burden of health in low-income countries is different. Infectious diseases and parasitic diseases are the most common threats there. However, between 2000 and 2011, only 4% of new therapeutic products and 1% of new drugs were for these neglected diseases, even though they accounted for only 11% of global diseases.

Artificial intelligence (AI) can play a key role in solving Alzheimer’s, antimicrobial resistance and other huge challenges. Pharmaceutical companies have begun buying technology companies specializing in artificial intelligence in the hope of speeding up discovery. In 2019, Swiss multinational health-care company Roche and artificial intelligence-driven drug R&D company Exscientia reached a $65 million partnership.

2.3 Development pattern of global biomedical cities

2.3.1 Country environment

From the perspective of the ecological environment of bio-medicine and medical health, developed countries represented by the United States, Germany, Switzerland, the United Kingdom, and Japan have obvious innovation advantages. Their pharmaceutical and medical industries are highly developed.

Europe and the United States are still leading regions in global industrial development. At present, the global biomedical industry is mainly distributed in developed countries such as the European Union and Japan. The total output value of the biomedical industry in the United States accounts for about 17% of GDP, and its R&D strength and industrial development lead the world. The United States occupies a dominant position in the global market for biological drugs, accounting for nearly 60% of the world's biological drug patents, and 90% of the global market for biological drugs comes from American companies, such as Merck, Johnson, Roche and Novartis. The UK has won 21 Nobel Prizes in the field of biomedical technology research and development, making it the world's second largest country in biomedical research and development. In the field of biomedical technology research and development, the United Kingdom has 21 scientists who have won the Nobel Prize and is the second largest biomedical research and development country in the world. Although the development of the biomedical field in Japan started later than that in Europe and the United States, their biomedical industry developed rapidly and became a leading country in Asia.

2.3.2 Urban innovation environment and ecosystem

The regional environment of various countries has a very significant impact on the bio-medicine and medical health industry. The most representative biomedical innovation cities in the world such as Boston, North Carolina, San Diego; Lyon, France; Cambridge, England; Basel, Switzerland; Osaka and Kobe, Japan; Singapore; Bangalore, India; and Beijing, Shanghai and Shenzhen in China.

2.3.2.1 Boston——eastern of US

In the initial stage of the development of the biomedical industry, Boston established the first university in the United States—Harvard University, laying the foundation for the development of the biomedical industry. At the same time, the government amended the law to recognize the commercialization of research achievements of American universities and research institutions. Also, the government protected patents, created a positive business environment, and supported and guided industry gathering. During the period of accelerated development, the Boston area was home to world-renowned institutions such as MIT, Whiteside Institute for Biomedical Research, Harvard University and Boston University. It also attracted bio-tech industry giants such as Biogen, Genetics Institute and Genzyme. Besides, Deval Patrick, the governor of Massachusetts, enacted a 1 billion dollars life sciences stimulus bill to encourage businesses to grow quickly. During the period of stability, many biomedical companies gathered in the Boston area, attracted by world-class researchers and leading pharmaceutical companies. Among the hundreds of enterprises gathered at that time, 34% of them are engaged in the production of medical and health products, whose products are a variety of successful drugs in clinical trials; 20% of them are engaged in the production of medical instruments and equipment; 10% of them are engaged in environmental and benign medical services; 7% of them are engaged in agricultural biotechnology research and development. The biomedical industry chain is complete. At the mature stage of development, Boston has over 240 biotechnology and pharmaceutical companies, covering the research and development of new drugs, the production of medical and health products, medical devices and equipment, as well as the environmental and veterinary fields.

A. The fundamental factor of development: Infrastructure and policy

As the most competitive bio-pharmaceutical industry cluster in the world, Boston brings together many top universities including Harvard and the Massachusetts Institute of Technology (MIT), has strong clinical resources such as Massachusetts General Hospital, New England Medical Center, and a number of leading science groups and laboratories in the life sciences, molecular biology, pharmacy and other related research fields.

In terms of policy support, the government provides financial support for scientific research results, various tax incentive policies, financing channels and subsidies, such as "employment creation encouragement projects", "R&D tax relief policies", and "Massachusetts Emerging Technology Fund".

B. Market structure: financing capacity, and R & D and innovation capability

First, the interactive mode of the association of government, production, learning, and research is an important guarantee for developing the biomedical industry in Boston. First-class scientific research institutions have bred advanced scientific research achievements and many high-caliber personnel. Enterprises industrialize the research results of scientific research

institutions and promote the promotion of scientific research technology. The government promotes the development of the biomedical industry and provides funding, policy and intermediary services for the development of the industry. This interactive model allows the innovation of the Boston biomedical industry to be further developed.

Secondly, in terms of financing, on the premise of muti-channel venture capital sources, the government adopts preferential policies such as financial incentives, loan guarantees and low repayment interest to provide support for the growth of new companies. According to the data, Boston ranked second in terms of the amount of venture capital it attracted in biotechnology and ranked first in terms of the amount of venture capital it attracted in bio-medicines in 2018.

In addition, many top universities such as Harvard University and Massachusetts Institute of Technology in Boston have cultivated many innovative talents for the local area. At the same time, the government also improves the living environment and social welfare and provides a practical platform for industrial talents to gather innovative talents and strengthen the ability to transform achievements.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

The Boston area is the most dynamic bio-industry cluster in the world, covering new drug R&D and production, medical and health products, medical devices and equipment, as well as environment and veterinary medicine. It is also a biotechnology cluster focusing on research and development, including top pharmaceutical companies such as Baijian, Merck, Pfizer, Novartis.

2.3.2.2 North Carolina, middle of US

In the early stages of development, the state government established the Research Triangle Park Committee. Their research attracted many emerging industries, promoting North Carolina from traditional agriculture to modern industry based on technology. At that time, the federal government shifted its economic center of gravity to the southern “sunshine belt” in order to achieve balanced domestic economic development, and North Carolina’s superior geographical location and moderate climate became the first choice for those going south, which has injected vitality into its biomedical industry development. Also, North Carolina’s educational resources are well developed, in which the University of North Carolina, North Carolina State University, and Duke University are all the best research universities in the United States. In addition, the local government invested a lot in nearby universities, infrastructure incubators and non-profit organizations in the park. During the accelerated period of development, the establishment of the Comprehensive Cancer Research Center of the University of North Carolina at Chapel Hill marked the official start of the biotechnology industry in the park; the state government further clarified that bioengineering is the most promising technical field and determined the development strategy of industrial cluster focusing on these core fields. Then, Glaxosmithkline, the pharmaceutical giant, moved into the park and the North Carolina Life Sciences Research Centre has been established. During the period of stable development, the government introduced venture capital to help incubate small and medium-sized enterprises and paid attention to the establishment of communication platforms between government enterprises and universities, integrating production, education and research. In the mature stage of development, North Carolina continuously improved its R&D capacity and produced many breakthrough and target drugs for the contemporary biomedical industry. The biomedical cluster

has matured and service supporting facilities are complete.

A. The fundamental factor of development: Infrastructure and policy

North Carolina has convenient transportation, large market coverage, a dense highway network and many airports. It relies on Duke University, North Carolina State University and the University of North Carolina at Chapel Hill to form an academic triangle, which has cultivated many high-quality life science professionals. In order to attract and retain scientific research talents, the local government has a clear division of labor and coordination of all parties. It has established many schools, shopping malls, and hospitals, with all kinds of supporting facilities for living, education and entertainment, providing a good living environment for high-tech talents.

In terms of policy, the Small Business Administration under the government is specifically responsible for providing loan guarantees and other financial services for small companies and providing long-term low-interest loans to settled companies. At the same time, the government actively cooperates with schools and enterprises to set up non-profit foundations to represent the land held by the government and sell it to potential users for building new factories. The stability and predictability of this policy and the transparency of operating procedures are highly recognized by investors.

B. Market structure: financing capacity, and R & D and innovation capability

North Carolina is mainly engaged in the development, investment and construction of the biomedical industry with enterprises, universities and other private forces as the main body. The government departments enhance the innovation ability and competitiveness of the biomedical industry through formulating policies and guiding investment. At the same time, fidelity Investment and Credit Suisse and other financial companies have entered the market to provide strong support for the financing development of biomedical enterprises.

The academic triangle formed by the University of North Carolina, North Carolina State University, and Duke University takes the promotion of regional economic development as one of its important missions and provides a strong talent pool for the innovation of biomedical companies. Also, the government has closely integrated the development of new technology products with scientific research in universities. The university conducts scientific research according to the actual needs of the market, and the scientific research results are quickly transferred to specialized R&D institutions for development. These new technologies developed are quickly transplanted into enterprises and transformed into high-tech products, forming a social and cultural atmosphere conducive to innovation and development.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

North Carolina has federal research institutions such as the National Institute of Environmental Health Sciences and the National Laboratory of the US Environmental Protection Agency under the National Institutes of Health. It also has world-renowned bio-pharmaceutical companies such as Glaxo-SmithKline, Bayer, Novartis and Merck. The research scope includes cell pathology research, genetic engineering, cancer and epidemic disease vaccine research and development, immune engineering, etc.

2.3.2.3 Santiago——western of US

In the initial stage of development, in order to solve the dilemma of a large number of high-tech personnel facing the transition and re-employment caused by the military industry

crisis in San Diego at that time, the government tried to find industries that could develop rapidly, incubate and support them with high technology, and absorb the unemployed. For this motivation, the government finally chose the biotechnology industry based on the characteristics of San Diego's regional development. After that, a series of industrial support policies adopted by the government directly gave birth to the establishment of a large number of biotechnology companies and related service organizations, which laid the foundation for the development of industrial clusters. During the accelerated period of development, the government invested a lot of money to establish the world's top research university: the University of California-San Diego. In addition, the University of California-San Diego sponsored the establishment of a non-profit organization, UCSD CONNECT, which brings together San Diego's universities, scientific research institutions, enterprises, and intermediary services to provide consulting services for companies in the high-tech and biotechnology fields. It is a channel connecting biotechnology companies with technology, capital, markets, partners and governments. Among them, the University of California-San Diego and some research institutions, represented by the Institute of Biology Salk and the Institute of Oceanography SCRIPPS, have effectively promoted the diffusion of knowledge, information and technology as the source of technological innovation. The government and financial institutions provide financial support for technological research. There are also some knowledge service institutions and intermediary organizations that provide information platforms to transmit scientific and technological information. Through the convergence of the above-mentioned information resources, enterprises can transform them into technological innovation applications. In the mature stage of development, San Diego focused on biotechnology and other R&D fields to create the most dynamic biotechnology industry cluster.

A. The fundamental factor of development: Infrastructure and policy

The climate in city of San Diego is pleasant. It is warm in winter and cool in summer. The public transportation network in the city is very developed. So, it is a very livable city. Also, the top school——the University of California-San Diego, is located here, attracting a large number of talents. It is the second largest city in California with the shortest time and the fastest growing biomedical industry in the United States.

In terms of policies, the government actively cultivates and attracts talents. For example, the BIOCOM Life Science Summer Camp established in 2005 provides scholarships to college and middle school students and teachers to encourage the cultivation and development of life science talents. At the same time, in order to remove the obstacles and threats encountered in industrial development, the municipal government has adopted multiple mechanisms and industrial communication methods to promote close cooperation between government, enterprises and scientific research institutions, and successfully build a biotechnology industrial cluster.

B. Market structure: financing capacity, and R & D and innovation capability

The CONNECT organization established by the University of California, San Diego and surrounding companies has developed a model for fostering banks, venture capital, law firms, accounting and other supporting companies, and promoted the creation of new scientific venture capital. At the same time, the government launched the Industry-University Collaborative Research Project (IUCRP) to enhance the interaction between academia and industry, and the research grant became the seed fund to promote the commercialization of scientific and technological achievements.

In terms of R&D and innovation, CONNECT initiated the Most Innovative Award and launched a "springboard plan" as a platform to connect retired entrepreneurs and new entrepreneurs, thereby supplementing entrepreneurs' business experience.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

As "the No. 1 biotechnology and pharmaceutical industry cluster in the U.S.", San Diego brings together some of the world's important bio-pharmaceutical companies, such as GlaxoSmithKline, Genentech, Takeda Pharmaceuticals, Thermo Fisher Scientific, and BD Life Sciences, forming the most dynamic biotechnology industry cluster.

2.3.2.4 Lyon, France

During the initial period of development, a group of leading companies in the field of biotechnology, represented by Sanofi and Mérieux Biotechnology, gathered in Lyon for development, guiding the development of biomedical companies. The biotechnology research institute of the University of Lyon is also located here, which has become a strong support for the growth of the biotechnology industry in Lyon. During the accelerated period of development, Lyon established a Biotechnology Council and provided corresponding financial policy support. For example, in the first five years, the enterprises in the park received a total of about 160 million euros of national financial special scientific research funding support through bidding for national biotechnology projects, and obtained guarantees from public financial funds, laying the foundation for the rapid development of the biomedical industry. During the stable period of development, Lyon maintains close cooperation with biotechnology parks in many countries, and focuses on diagnostic vaccines, innovative medical therapies and infectious disease monitoring, and establishes an image as a leader in the research field of the vaccine industry and infectious diseases. In the mature stage of development, Lyon will continue to develop steadily in the vaccine industry and infectious diseases, extending to the direction of small trials and detection technologies.

A. The fundamental factor of development: Infrastructure and policy

As the third largest city in France after Paris and Marseille in urban population, Lyon is an important cultural and artistic center in France and even in Europe, with numerous universities and scientific research institutions. It is also home to the People's Hospital of Lyon, the second largest comprehensive medical system in France, and the Jean-Merieux Laboratory, known as the most advanced bio-safety laboratory in the world. It has perfect infrastructure, prosperous business and convenient life.

In terms of policies, Lyon has set up various funds to give enterprises a large amount of financial support and corporate support. The government has driven the formation of the Lyon Biotechnology Park, and adopted an association-style management to coordinate the allocation of financial resources and manage technical service resources, achieving complete marketization operation and sufficient industrial capital reserves.

B. Market structure: financing capacity, and R & D and innovation capability

The City of Lyon has a large-scale funding system for bio-medicine financing. In addition to government investment, the bio-industry parks formed by the gathering also set up a systematic industrial fund system through the council. Four types of funds with different functions (regional project funds, national Project funds, European project funds, and world cooperation funds) have

distinct levels and strong applicability of objectives, which have become an important factor in attracting start-ups and venture capital companies to gather.

In the field of biomedical innovation, THE University of Lyon actively interacts with enterprises in the form of direct talent pool, providing enterprises with a large number of high-level talents and emerging technologies. Also, Lyon attaches great importance to exchanges and interactions with other countries and cities. Through participating in and hosting internationally influential exhibitions and events, it explores international cooperation, and strengthens its own innovative research and development capabilities.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

The early gathering of leading biomedical companies promoted the Lyon Biotechnology Park, which led Lyon to build a scientific and technological innovation platform centered on R&D, incubation and even basic research. Lyon has gathered companies such as Sanofi, Imaxio and Orega Biotech. It focuses on diagnostic vaccines, innovative medical therapies and infectious disease monitoring, and covers academic research, technology research and development, trial production and other industrial chain links. At this stage, Lyon has established an image as a leader in the research field of the vaccine industry and infectious diseases.

2.3.2.5 Cambridge, UK

Many small factories moved from London to Cambridge in the early stages of development to reduce costs. Later, the Trinity College in University of Cambridge led these factories establish the Cambridge Science and Technology Park, encouraged university students to make connections with industry and increased the return on basic research and industrialization of achievements. During the acceleration period of development, the University of Cambridge established a sound technology research and development incentive mechanism after the approval of the Science Park outline plan, encouraged teachers and students to start their own businesses and commercialized scientific research results. After that, many small and medium-sized enterprises engaged in bio-pharmaceutical research, such as Cantab Pharm, settled in the park and cooperated with large companies in the form of technology transfer. In the stable period of development, the Cambridge biomedical industry began to provide professional consulting services for enterprises. The rapid growth of business incubators, venture capital and funds has led to the continuous expansion of small and medium-sized enterprises. Some large-scale listed companies appeared. In the mature stage of development, Cambridge locks in the world's top research areas of bio-pharmaceuticals, focusing on the treatment of drugs and vaccines for diseases that have not been overcome.

A. The fundamental factor of development: Infrastructure and policy

The Cambridge town, which a university lays inside is an area full of vitality and vitality. It combines prosperous business and beautiful rural scenery in England. With a well-developed transportation network and convenient road transportation, it has been attracting investment from all over the world, forming a highly innovative economic form with close collaboration between universities, emerging companies and large multinational companies.

In order to attract cutting-edge talents and promote innovation and development, the government provides incentives for talent entrepreneurship, such as providing short-term small loans for scientific research projects and providing assistance in the creation of new

knowledge-based enterprises.

B. Market structure: financing capacity, and R & D and innovation capability

In order to provide a good development environment for enterprises, Cambridge has established multiple financing channels, and provides financial support for enterprises through government R&D funds, banks and private equity funds.

In terms of R&D and innovation, the government, universities, and enterprises complement each other to promote the innovative development of the biomedical industry. With Cambridge University's biomedical-related colleges and affiliated scientific research institutions as the main body of R&D support, the government has established an entrepreneurial incentive mechanism. The major consulting companies gathered in Cambridge provide direct product R&D and production support on the basis of providing consulting services for enterprises. Multi-party cooperation strongly promotes the path of pharmaceutical innovation.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Cambridge focuses on major disease pathology research, genetically modified products, vaccine research and development and other sub-industries, covering basic pathology research, drug research and development and performance testing, clinical trials and other steps, creating Cambridge Science with Cambridge University as the core point and a large number of small and medium-sized enterprises. Famous companies such as Arecor and NAPP have settled in the park, forming the famous Cambridge phenomenon.

2.3.2.6 Basel, Switzerland

In the initial stage of development, Gegi, Ciba and Sandoz, which deal in chemical and dye trading, merged into Novartis, and the international headquarters was established in Basel. After that, a Bio Valley promotion group was established and the Basel biomedical industry began to develop. During the accelerated period of development, this cross-border project quickly aroused the interest of the media, so Basel further used international attention to promote the growth and industrial development of biomedical companies. In the stable period of development, the world-renowned multinational companies Novartis, Roche, Actelion, Baselia Pharmaceuticals, Speedel and other young growth companies are headquartered in Basel, covering modern biotechnology, pharmaceutical preparations, agricultural products management, nanotechnology, medical technology, specialty chemicals and other various aspects of life sciences. In the mature period of development, Basel promoted international cooperation as the key to its scientific development strategy, focusing on the development of innovative research and biotechnology, and the biomedical industry is mature.

A. The fundamental factor of development: Infrastructure and policy

Known as the "best weather" city in Central Europe, Basel is the most economically dynamic region in Switzerland and one of the most productive and innovative cities in the world. With a well-developed transportation network, it is the most important transportation hub connecting France, Germany and Switzerland, where the highways of the three countries meet. Basel has some of the world's top universities including the University of Basel and ETH Zurich. In terms of finance, the International Settlement Bank, which plays an important role in international finance, is also located here.

In terms of policy, the government's strong policy support makes the region expected to

become the “pharmaceutical heart” of Europe. The government subsidizes hundreds of millions of Swiss francs for basic biotechnology research through the National Science Foundation every year, establishes network resources such as the Swiss biotechnology basic database and the Swiss life science basic database, and regards the promotion of international cooperation as the key to its scientific development strategy.

B. Market structure: financing capacity, and R & D and innovation capability

In terms of financing for the biomedical industry, Basel makes full use of various funding channels. The government adopts direct capital investment to provide financial support for different areas of the bio-pharmaceutical industry. Various venture capital and various funds provide support for bio-pharmaceutical companies at different stages of development. International banks, Swiss banks and a large number of private, state, and regional Banks provide customers with comprehensive financial consulting and the most modern financial tools. Under the framework of multi-channel financing, the biomedical industry has developed rapidly.

In terms of innovation, the University of Basel and ETH Zurich have played a role in cultivating academic talents, while Roche and Novartis, as large pharmaceutical companies, are more conducive to incubating small and medium-sized technology companies. Well-known research institutions backed by pharmaceutical companies have created the best conditions for drug development. At the same time, the government protects high-input and high-risk biotechnology patent inventions, enhances corporate competitiveness, and creates a policy environment conducive to industrial innovation and development.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Basel focuses on monoclonal antibody drugs, focusing on the development of vaccines, blood products, recombinant protein drugs, peptide drugs, biological extracts, and gene therapy. It has attracted the headquarters of large companies such as Novartis, Roche and Johnson & Johnson, Eli Lilly, Branches of large pharmaceutical companies such as Pfizer and Sanofi.

2.3.2.7 Kobe, Japan

In the initial stage of development, in order to recover the losses caused by the Great Hanshin Earthquake, Kobe City proposed the concept of building a "Medical Industry City". It means that people establish an economic and technological park on the Kobe artificial island to attract well-known domestic and foreign pharmaceutical companies to set up high-tech Research center and transform research results into products. During the accelerated development period, the core facilities of the cutting-edge medical center, the Kobe Clinical Research Information Center, the Kobe Biomedical Creation Center, the Kobe Biotechnology Research Talent Training Center, and the Kobe University Enterprise Support Center, were officially launched. At the same time, the government issued a series of policies, which encourage universities to establish new companies and carry out comprehensive reforms to universities and research institutions in order to strengthen the independence of universities and research institutes and improve their commercial operation capabilities. During the stable period of development, the government strengthened the integration of government, industry and academia, and successively formulated research exchange promotion laws, frontier research, inter-provincial basic research, and regional mobility research systems to promote the common development of technology and industry. In development stage, Kobe is not limited to become pure medical related industry base, but by

building from basic research to clinical application of the structure of the integration of industrialization as the goal, to improve the economic activity due to promote the deepening of existing industries and employment stability, constantly improve the medical and public health welfare service level, and improve the medical technology of Asian countries to contribute to the international community

A. The fundamental factor of development: Infrastructure and policy

Kobe is an important city in the Osaka metropolitan area, one of the three major metropolitan areas in Japan. It has a prosperous economy and a well-developed railway network. It gathers more than 180 well-known medical and pharmaceutical companies, research institutions and universities. In 2012 ECA International, a Consultancy based in Switzerland, it ranked fifth in the world's livable cities, which is the only Japanese city in the top 10.

In terms of bio-medicine policy, Kobe City provides a 2 billion yen research and development support fund to support companies with insufficient funds. For companies in the first three years of entering Kobe City, it adopts "office rentals are and taxes on fixed assets are reduced" policy.

B. Market structure: financing capacity, and R & D and innovation capability

First, Kobe City adopted a "cooperative combination" operation and a development model of government-civilian cooperation. The Kobe industrial Park is jointly funded and managed by the Central government of Japan and 20 private enterprises, which not only greatly saves the cost of government management, but also plays a supporting role for the development of biotechnology.

Second, the government has also reformed patent ownership, changing patents from professors to universities. This has greatly promoted the enthusiasm and initiative of universities to transform biotechnology research results into commercial products.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Kobe's pharmaceutical industry is composed of three core industries: medical device development, pharmaceutical clinical research, and clinical application of regenerative medicine. There are buildings such as a cutting-edge medical center, a comprehensive research center for genetic and regenerative science, a medical industry support center, and a training center. The Advanced Medical Center (IBRI) is engaged in cutting-edge research related to clinical testing and clinical applications of medical equipment and regenerative drugs. The Genesis and Regeneration Science Comprehensive Research Center (CDB) and Kobe Clinical Research Information Center (TRI) under the Institute of Physics and Chemistry are beneficial supplements to the research capabilities of IBRI.

At present, Kobe City has nearly 200 companies and organizations in the fields of medical equipment, pharmaceuticals, and regenerative medicine, and more than 10 Japanese cutting-edge medical research institutions.

2.3.2.8 Osaka, Japan

In the initial period of development, the Osaka government added the function of "life science research and communication" to the regional development positioning for the first time in its planning, and issued a number of policies to encourage schools to commercialize technology patents. Under the guidance of a number of policies, the Osaka biomedical industry began to take off. During the accelerated period of development, the Japanese government has

issued a national strategy for establishing the country in the bio-industry, making the bio-industry a national pillar industry, and the government has increased its R&D investment in the field of biotechnology. A large number of companies and incubator projects have settled in the Biomedical Industrial Park in Osaka, which has strengthened the interaction between industry and school technology research and development. In the mature stage of development, Osaka, Japan has established a complete industrial chain from R&D to production.

A. The fundamental factor of development: Infrastructure and policy

Osaka City is a popular center in the Kansai region of Japan. It has complete shopping facilities, a variety of goods, and developed circulation. It has high-quality educational resources, including Osaka University, one of the universities with the highest teaching and research standards in Japan, and the Kansai University, one of the well-known "Cage with stand " private universities. In 2019, it won the 41st place on the Global 500 Cities list and the 8th in the global sustainable competitiveness.

The government has also proposed corresponding tax and subsidy policies to reduce local taxes for small and medium-sized enterprises, and subdivided money into investment subsidies and R&D subsidies to fund different types of companies.

B. Market structure: financing capacity, and R & D and innovation capability

The sources of investment in the biomedical industry in Osaka are relatively single, mostly from the government and public funds, and PE/VC is not flexible.

In terms of innovation, the government has led the incubation of industries and developed a number of commercial incubation facilities including NIBIO. It has various hospitals and research institutes such as the Institute of Bio-sciences of Osaka University and the Institute of Biomedical Innovation, attracting a large number of experts and scholars every year.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Relying on a large amount of government funding, the pharmaceutical industry in Osaka has concentrated into two cores: Caito Life Science Park and North-Osaka Regional Industrial Cluster, equipped with the entire industrial chain from R&D to production, focusing on protein synthesis, globin peptide synthesis, poly-peptide research, reagents research and production, cancer treatment research, and research and production of health food, covering various life science fields such as biological industry, medicine, food, cosmetics, and health care.

2.3.2.9 Singapore

In the initial stage of development, the Singapore government established the Research, Innovation and Enterprise Committee, under which the Life Sciences Executive Committee was established, and the International Advisory Council composed of top international scientists provided strategic advice for it and jointly guided the development of the industry. At the same time, the Singapore government set up One-North Technology Park to develop high value-added companies such as biomedical research and development. During the development acceleration period, the Singapore Science and Technology Research Agency and Bio*One Capital Co., Ltd. invested in One-North. Then, One-North expanded the construction of the life science park. Bayer Institute of Medicine and Healthcare and the GlaxoSmithKline Cognitive and Neurodegenerative Disease Research Center settled in. Also, the government has increased funding for R&D, innovation and entrepreneurship, which has led to the rapid development of

the biomedical industry. During the stable period of development, Singapore's biomedical industry has formed an industrial agglomeration pattern based on "Tuas manufacturing" and "Qiao R&D" as the source of innovation. Many international top multinational companies, including AbbVie, Alcon, Amgen, Novartis, Pfizer, Roche, Sanofi, Shire and Merck have all set up their Asia-Pacific regional headquarters, large manufacturing plants or R&D centers in Singapore. In the mature stage of development, based on the previous industrial structure, Singapore focus on investing in health and biomedical fields, building a global human health leadership center, and transforming and applying research and development results to create higher economic value.

A. The fundamental factor of development: Infrastructure and policy

Singapore is the fourth largest international financial center after London, New York, and Hong Kong, with a beautiful environment and a reputation as a "Garden City". Its infrastructure is complete. In terms of education, it has the National University of Singapore and Nanyang Technological University, two top universities, providing technology and transporting talents to the local area. In terms of transportation, it has a highly developed transportation network and is an important transit port and aviation centers contacting Europe, Africa and Oceania together.

In terms of policies, the government has set up a corporate research award program and biotechnology entrepreneurship seed funds. It also used tax incentives to attract talents and companies.

B. Market structure: financing capacity, and R & D and innovation capability

The government has adopted a three-pronged investment strategy of hiring industry experts, leading investment by the government, and driving star companies. The government-led industry incubation, the establishment of government industry funds and PE/VC investment has ensured the development direction and funding of Singapore's biomedical industry.

The National University of Singapore and Nanyang Technological University directly supply talents and deliver the technology transformation needs, which promote the innovative vitality of Singapore's biomedical industry.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Singapore's bio-pharmaceutical industry gathers to form the Singapore Qi'ao Life Science Park, which has many internationally renowned pharmaceutical companies such as Abbott, GlaxoSmithKline, Novartis, Roche, etc.

From the perspective of the industrial chain, Singapore's biomedical industry involves R&D, testing and other aspects, covering biomedical research and production, medical device R&D and manufacturing, and disease research.

2.3.2.10 Bangalore, India

At the initial stage of development, the Ministry of Biotechnology of India proposed a development strategy for the biotechnology industry and plans to establish a biotechnology park during the Ninth Five-Year Plan of the National Economy. During the accelerated period of development, the Indian central government established a Bio-IT center in Bangalore to carry out gene sequencing and analysis. In addition, the Indian government relaxed restrictions on the pharmaceutical industry, and the Ministry of Biotechnology introduced the "Innovative Research Program for Small and Medium-sized Enterprises", aimed at promote cooperation between the

state-owned and private sectors, support the innovative activities of small and medium-sized enterprises, help them establish cooperative links with government research institutions, and promote the industrialization of research results. During the stable period of development, the government established pharmaceutical R&D support funds, and universities such as Bangalore University have cultivated a large number of biomedical industry talents, attracting world pharmaceutical giants such as Novartis, Merck, Johnson & Johnson, GlaxoSmithKline to establish pharmaceutical companies or pharmaceutical sales in India the company. Various resources have a high degree of collaboration to promote the sustainable development of the biomedical industry in Bangalore. In the mature stage of development, India has taken a leading position in the world in terms of its medicinal genes, genetic disease vaccine development, bacterial gene sequencing and so on, attaches great importance to medical research and development, vigorously develops generic drugs, and builds a world clinical research base.

A. The fundamental factor of development: Infrastructure and policy

Known as the "Silicon Valley of Asia", Bangalore has a beautiful environment and a pleasant climate, which is suitable for living. The area is home to many prestigious universities such as the Indian Institute of Technology, the Indian Institute of Management, the National Institute of Advanced Studies, and the Indian Institute of Information Technology, which attracts many talents. It is an emerging biomedical base in India, focusing on bio-medicine research and development, and ranking 104th on the list of the top 500 global cities in 2019.

At the policy level, the government has greatly streamlined the approval process for foreign investment, exempted tariffs and excise duties on imported drugs and materials for clinical purposes. It also reduced the import duties on pharmaceutical companies from 25% to 5%. This series of measures has created a policy environment that encourages the development of small and medium-sized enterprises, prompting a large number of biomedical companies to invest in India.

B. Market structure: financing capacity, and R & D and innovation capability

In terms of financing, the government has listed biotechnology as a priority area for investment and formulated preferential policies to encourage commercial banks to give priority to providing financial support to the biotechnology field. At the same time, it has increased support for the "SME Innovation Research Program" and provided grants or loans to small and medium-sized enterprises.

The Indian Council of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council and many universities have a large number of professionals and cutting-edge science and technology in the fields of molecular biology, microbiology, biochemical engineering, organic chemistry and chemical engineering.

C. Industry pattern: Distribution of biomedical industry and companies, and key development areas

Bangalore focuses on bio-medicine research and development. It has India's first Institute of Bio-informatics and Applied Biotechnology (IBAB) and some human genetic centers. India's largest pharmaceutical company, Nanxin Corporation, is also located here.

As the "Silicon Valley of Asia", Bangalore is leading in IT technology, and Amazon will also make full use of this advantage to open an online pharmacy in India to provide services to the city of Bangalore.

2.4 Innovative development model of global biomedical industry cities

Based on the analysis of global biomedical innovation cities, biomedical companies gather in the form of industrial parks. According to the classification of driving factors, cities can be divided into four developments: school-driven, enterprise-driven, government-driven, and hybrid-driven. Cities would go through different stages of development.

2.4.1 School-driven

School-driven refers to a model in which cities rely on the school's technical issues, equipment resources and funds to drive the development of their own biomedical industry. A typical city is represented by Cambridge, UK. With the world's top university——Cambridge University as the core, it relys on its biomedical related colleges and affiliated scientific research institutions as the main body of research and development, and vigorously driving Cambridge to develop its own biomedical industry, thus attracting Pfizer, Merck, Johnson, Johnson, GlaxosmithKline and other famous enterprises to settle in, effectively promoting the road of pharmaceutical innovation.

2.4.2 Enterprise-driven

Enterprise-driven means that the city relies on the presence of some well-known large companies to attract talents and other companies to develop the biomedical industry. Its representative city is Basel, Switzerland. The development of Basel's biomedical industry and the establishment of Novartis are inextricably linked. As early as the 18th-19th centuries, Gegi, Ciba and Sandoz, which traded in chemicals and dyes, were established in Basel. In 1996, the three companies merged into Novartis, and the international headquarters was established in the region. At the end of 1996, a Bio Valley promotion group was established, and the Basel biomedical industry began to develop. The cross-border projects between these three regions quickly aroused media interest, so Basel used international attention to promote the growth and industrial development of biomedical companies. Nowadays, Basel has gathered 6 of the world's top ten pharmaceutical companies, and its biomedical industry is mature.

2.4.3 Government-driven

Government-driven means that cities rely on the funds and supportive policies invested by governments at all levels in the biomedical industry to provide good growth soil for the development of small and medium-sized biomedical enterprises. Singapore is an important representative of this type. Singapore established a biotechnology investment venture fund in the early 1990s and began to pay attention to and invest in the biomedical industry. In the 21st century, the Singaporean government took the biomedical industry as a strategic industry and continuously launched such as "RIE2020" (Research, Innovation and Enterprise 2020 Program), Pharmaceutical Innovation Program (PIPS) and other encouraging policies to promote industry development. With the key support of government policies, Singapore has gathered many top bio-pharmaceutical companies in the world after more than 30 years of development, forming three major medical and pharmaceutical parks. Its bio-pharmaceutical industry is mature.

2.4.4 Hybrid-driven

Hybrid driven means that cities rely on various development resources, such as government enterprises and schools, to make the biomedical industry develop and grow. The specific representative region is Lyon, France. The biomedical industry in Lyon takes the "integration of production, education and research" as its development model, and has built a scientific and technological innovation platform centered on R&D, incubation and even basic research. In terms of educational resources, many higher education institutions such as the University of Lyon and the University of Saint-Ota have cultivated relevant talents for the development of the biomedical industry. At the same time, the University of Lyon actively interacts with companies in the form of direct talent pools, providing companies with a large number of high-level talents and emerging technologies. It has also attracted the presence of large pharmaceutical companies such as Sanofi and Merck, providing strong technical support for the development of the biomedical industry. In terms of policies, Lyon has set up four types of funds with different functions to give enterprises a large amount of financial support. Therefore, with the support of strong professional university enterprises and other scientific and technological support, as well as business and financial services, Lyons has become a world-class competitive base and source of biotechnology innovation.

2.5 Post-epidemic era trend

At the beginning of this year, Covid-19 broke out and spread around the world, and the crisis impacted the globalization pattern at the time of the rapid development of the global biomedical industry. As of August 11, 2020, more than 19.9 million COVID-19 cases have been reported worldwide, with more than 732,000 deaths. Now, the current global infection cases continue to exceed 250,000 every day. Five months after the announcement of a global pandemic, people have begun to feel the broader and longer-term impact on the health-care system.

First, the prospects for the clinical development of COVID-19 are still unclear. Although unprecedented progress has been made so far, it is still unclear whether or when the vaccine will prove successful and be widely promoted worldwide. Before determining the availability, the third phase of clinical trials to prove safety and effectiveness needs to be completed. The goal is to provide the vaccine within the 2021. At present, the treatment rate of many chronic diseases has stabilized, but more and more evidence shows that the diagnosis and treatment of certain diseases, especially cancer patients, are being delayed, which have raised concerns about long-term health outcomes. At the same time, the treatment of several mental illnesses has shown an upward trend, which reflects the pressure of the pandemic and long-term confinement restrictions. Also, since the outbreak of the pandemic, consumer health care products purchase patterns have been unstable. Behavior changes and reduced consumer willingness have further restrained demand, which is expected to continue throughout the economic downturn.

Second, recruitment and routine trial activities are disrupted due to confinement restrictions. By re-prioritizing research on coVID-19 treatment and vaccine trials, the future virtual trial model will have a broad impact on clinical research and will be a more patient-centered step in clinical research. At the same time, the COVID-19 environment needs to be transformed from traditional methods. How to deliver health care and how to interact with patients and health professionals, innovative technologies and virtual solutions that promote telecommunications are critical to achieving continuity in all these areas and to final developing

patient-centered solutions and services that improve health outcomes.

In addition, the global outbreak and spread of the new crown epidemic has aroused the attention of the United States to China's pharmaceutical industry, accelerated the United States' restrictions on China's biomedical technology industry, and accelerated the transfer of pharmaceutical and other national security strategic industries to the country. For this reason, the U.S. Senate and House of Representatives have proposed numerous draft laws. At present, some of these bills have been signed into law, and some are still in progress and have a long-term effect. Judging from the passed and legally effective documents, and the bills representing the latest trends, the United States' restrictions on China's medical supply chain (which has significant advantages) have risen to the height of national security.

3. Focus on innovation and development of biomedicine in China

3.1 China biomedical industry trend

In recent years, our country's bio-pharmaceutical industry has continued to grow, mainly driven by growth in segmented areas, policy promotion, and stable investment and financing activities. China's bio-pharmaceutical pharmaceutical manufacturing accounted for a rapid increase in the global proportion, from 14% in 2015 to 19% in 2019. The growth rate of pharmaceutical manufacturing far exceeds that of the world. In 2019, the global bio-pharmaceutical market grew by 4.4%, and China was 10.3%.

3.1.1 Continuous favorable policies

Since the State Council first raised the bio-pharmaceutical industry to the height of a pillar industry in 2015, several policies have been issued to favor the development of the bio-pharmaceutical industry. Especially for all kinds of innovative drugs, the state has introduced a series of key measures to accelerate the launch of innovative drugs. The direction of reform is to increase speed and emphasize evidence. Specific measures include special treatment of new and good drugs, ICH accession, trial implementation of the MAH system, establishment of an accelerated review path (breakthrough therapy drugs, conditional approval, priority approval, special approval), and the use of overseas data. At the same time, the process is simplified, and the time limit is specified. For example, the clinical trial is changed from the "approval system" to the "expired default system". Also, the review evidence becomes rationalized. For example, non-clinical endpoint indicators or non-confirmatory clinical evidence should be accepted by referring to the real-world evidence to simplify the process, and the time limit should be set to extrapolate the indications for bio similar drugs by referring to the original research.

3.1.2 Improved medical insurance environment

Since my country issued the National Medical Insurance Catalogue in 2000, the first and the second adjustment after the publication of the medical insurance catalogue were in 2004 and 2009 respectively, and the time difference between each adjustment was 4-5 years. After that, negotiations on national medical insurance access began. The third national adjustment and national medical insurance negotiations for anti-tumor drugs in the medical insurance catalogue were carried out in 2018. Since 2019, the medical insurance catalogue has been adjusted and implemented a dual-track system. The regular and frequent medical insurance catalog update mechanism has enabled innovative drug products to have an earlier opportunity to enter the scope of medical insurance reimbursement. Taking various anti-cancer drugs as examples, based on the huge unmet clinical needs and medical insurance access negotiations, the commercial return rate can be quickly realized. Specifically, the K drug was listed in China in 2018, and the sales volume reached more than 20 million yuan in the second year of listing, and many other anti-cancer drugs have also achieved the "explosive" growth trend.

3.1.3 China healthcare industry maintains a rapid growth.

In 2014, there were 157 venture investments in China's healthcare industry with a financing amount of 18 billion yuan. By 2018, it reached 602, achieving a financing scale of 98 billion yuan, and the proportion of financing is increasing year by year. Among them, biotechnology has gradually become the most popular sub-industry of investment institutions, and financing accounted for the total financing of the healthcare industry from 16% in 2014 to 33% in 2018.

3.2 Urban development pattern of China biomedical industry

From the perspective of the spatial distribution of the biomedical industry in various countries, most of the core areas of the biomedical industry are concentrated in areas with dense scientific research institutions and highly developed economies in the country. Our country's biomedical industry has gradually formed a spatial pattern of industrial development centered on the Yangtze River Delta, Bohai Rim, and Pearl River Delta. The Yangtze River Delta region's biomedical industry has a relatively high level of innovation and international exchanges and has gradually formed a biomedical industry cluster with Shanghai as the core and Jiangsu and Zhejiang as the wings. The Bohai Rim region has abundant clinical and educational resources and has formed an industrial cluster with strong innovation capabilities around Beijing. The Pearl River Delta region has a mature market economy system, which is adjacent to Hong Kong and Macau and has strong external radiation capabilities. It has formed a biomedical industry cluster with developed commercial networks around key cities such as Guangzhou and Shenzhen.

3.3 Advantages of China biomedical industry

From a domestic perspective, my country's biomedical industry has huge development potential, and there is still a lot of room for development in the domestic market.

Development advantages are mainly reflected in my country's huge market potential, government policy support, increased investment in research and development, the accumulation of talent in developed cities, and the continuous improvement of the financial system of developed cities.

3.3.1 The deepening of our country's population aging and the growth of residents' disposable income are important driving forces for the continued growth of my country's pharmaceutical industry.

At present, China has entered an aging society. In 2001, the proportion of the population aged 65 and over in China reached 7.1%, and in 2006 it had risen to 7.9%. According to forecasts, the proportion of the population aged 65 and over in China will reach 8.3% in 2010 and 16.1% in 2020. With the increase in this proportion, the proportion of medical and health expenditures in GDP may exceed 10%. The report of the 17th National Congress of the Communist Party of China proposed for the first time that the per capita GDP in 2020 will quadruple from 2000, and the per capita GDP will exceed 3,500 US dollars. Based on this calculation, the per capita health expenditure will exceed 350 US dollars, and the pharmaceutical market will reach 1.5 trillion yuan.

3.3.2 China's huge medical needs have not been met.

As my country’s industrialization, urbanization, and population aging process continue to accelerate, the health effects of residents’ lifestyles, ecological environment, and food safety are

gradually appearing. The top five cancer types in China in terms of incidence are lung cancer, gastric cancer, tuberculosis, rectal cancer, liver cancer and thyroid cancer, and it is expected that the incidence of cancers in the top rankings will further increase in the future. In January 2019, the National Cancer Center released the latest national cancer statistics. The report showed that in 2015, there were about 3.929 million cases of gross tumors in China, an increase of 125,000 or 3.2% from 3.804 million in 2014. In addition to cancer, the incidence, illness and deaths of chronic diseases are increasing, and the burden of disease among the people is also increasing. Chronic disease has become a major public health problem that seriously threatens the health of our residents and affects the country's economic and social development.

3.3.3 The development and application of new technologies

With the development and application of new technologies, advances in genetic technology, materials, and processes will promote the development of medical precision. The combination of artificial intelligence, genetic sequencing, and biotechnology will bring more personalized treatment methods. Medical big data will promote the dual control of efficacy and cost. Various consumer medical equipment combined with big data begin to rise. All these emerging biomedical fields also bring huge market opportunities.

3.4 Challenges in the development of China's biomedical industry

3.4.1 The concentration of enterprises is low, and the industry needs further integration.

Small and disorganized has always been a typical feature of the development of China's pharmaceutical industry. Chinese pharmaceutical companies do not have absolute leading companies. Large but not strong has always been a problem that plagues the development of the industry. In terms of industrial concentration, the sales revenue concentration of the top ten pharmaceutical companies in the world has increased from 30% in the 1990s to 54%, showing a highly concentrated trend. In contrast, the concentration of the domestic pharmaceutical manufacturing industry has always been relatively low. In 2006, the concentration of the top 10 pharmaceutical manufacturing industries was less than 12%, which is still down from 2005. From the perspective of the concentration of sub-sectors, the concentration of chemical raw materials and biological products is relatively high, while the concentration of traditional Chinese medicine is the lowest. Except for chemical preparation drugs, the concentration of other sub-sectors in 2006 decreased compared with 2005.

3.4.2 Domestic pharmaceutical companies have low R&D investment and insufficient innovation capabilities.

Chinese pharmaceutical companies currently invest no more than 3% in research and development expenses, and generally only 0.5% to 1.0%. Up to now, only 65 new drugs with proprietary intellectual property rights have been independently created, and the number of generic drugs has reached over 95%. The development history of China's pharmaceutical industry is almost the development of China's generic drugs. Therefore, the uniqueness of new drug products registered by domestic pharmaceutical enterprises is not strong, which leads to the

situation of repeated development and fierce competition in the market for similar products with similar dosage forms. The homogeneity of products leads to increasingly fierce market competition, vicious price competition, and huge waste of research power and capital, which are already very limited.

3.4.3 The outstanding performance shows in the gap in process technology in APIs and innovative formulations.

China's chemical raw materials generally undergo new product development, cultivating the domestic market, and exporting to occupy foreign markets. The chemical API exports capital and production technology from developed countries, facilitating a phase of transfer in which capital and technology are combined with cheap labor in developing countries. China and India are competing fiercely for the world's bulk drug market.

3.4.4 Hospitals are still the main channel for drug consumption.

According to statistics, in 2018, the drug sales of the three major terminals of my country's public hospitals, primary medical institutions, and retail pharmacies were 1,713.1 billion yuan, of which public hospitals accounted for 67.4%, retail pharmacies accounted for 22.9%, and public primary medical care. The proportion of terminals is 9.7%. The lag in the reform of the medical and health system has forced pharmaceutical manufacturers to lower their sales focus, and the distribution of pharmaceutical retail terminals is unfavorable, with low-price competition as the main means. With the spread of consistency evaluation and national volume procurement, the transformation of drug consumption channels is imminent.

3.5 Opportunities for China bio-medicine industry in the post-epidemic era

The outbreak of the new crown pneumonia epidemic has brought huge challenges to the development of the biomedical industry, but it also provides a good opportunity for promoting the reform of the industrial supply side. In the short term, the number of patients accepted by hospitals at all levels has dropped significantly due to various factors, and the continuous treatment of many chronic disease patients has been affected. The new crown epidemic page has caused a shortage of medical resources, limited trial researchers, and difficulty in recruiting subjects, so routine clinical trials delays have occurred. Due to lack of emergency plans, reduced factory output in some areas and decline in terminal market sales, some pharmaceutical companies are under greater pressure on short-term profits. At the same time, it has also exposed the lack of disease control equipment in China's primary hospitals, and high-end consumables and equipment still rely on imports Wait for some questions. The outbreak of the new crown epidemic has also brought some new opportunities. Taking Internet hospitals and medical e-commerce platforms as examples, the outflow of e-prescriptions, medical insurance access to the Internet, and online renewal of prescriptions have developed rapidly during the outbreak. The transformation of clinical research to tele-communication and the mechanism of compassionate use of drugs have been significantly accelerated. The digital and intelligent business model will become the future development trend of the drug circulation field. The national biosafety has reached unprecedented heights, and the National Development and

Reform Commission has also issued standards for the construction of bio-safety laboratories, bringing huge market increment. The short-term growth in demand for disease prevention and diagnosis equipment will drive the long-term growth of a range of segments in medical devices and in vitro diagnostics.

4. China Biomedical City Innovation Index (CBCII)

4.1 Development background

From the perspective of the macro-Bio-medicine market trend, the macro-elements of my country’s biomedical innovation system are constantly being optimized, and the development investment momentum is driven by the investment of leading biomedical companies in various cities in the context of the continuous growth of my country’s biomedical industry. While continuously driving the development of regional industries, the development of the biomedical industry has formed a relatively obvious key area, and the innovative development of cities, as the core in the world, has become the main theme of the development of my country's biomedical industry.

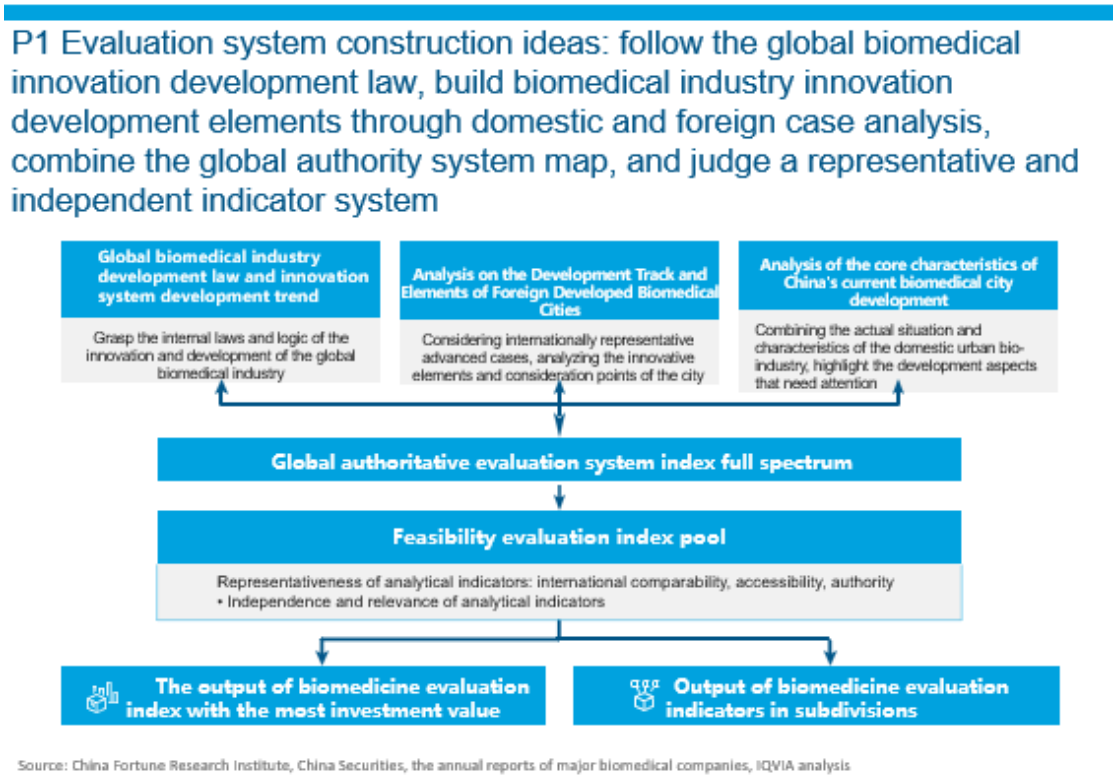
But at the same time, there are still many fundamental constraints on the innovation and development of China’s biomedical industry, which are mainly reflected in the homogeneous competition across the country. The cities have failed to form good focus and overall planning while developing industrial clusters. In addition, compared with similar international leading regions, China’s bio-pharmaceutical industry is small in scale and slow in growth, indicating that there are fewer leading companies or companies involved in high-growth fields. From the perspective of urban industry support policies, support lacks bright spots and the strength does not break through. A series of policies are lagging behind. Top-level design is lacked, and delivery cycle is long. At the same time, the basic supporting facilities and R&D supporting facilities for urban industrial development are not perfect. The service efficiency needs to be further improved, and the concentration of middle and high-end talents is not high. Finally, from the perspective of urban capital operation, the types of industrial development funds or government guidance funds are few. The scale is small, and the degree of social capital involved in industrial development is low. Many cities have failed to create a vibrant capital operating environment.

How to construct the innovation system of the biomedical industry and improve the internal force of industrial innovation development have become the main proposition that needs to be answered by cities that take the biomedical industry as the pillar industry, which also increasingly reflects the urgency of the evaluation of the current urban innovation ability. Therefore, the establishment of the "China Biomedical Innovation City Evaluation System" originated from the call for innovation and development of China's biomedical industry.

4.2 Construction of Innovation Index System

4.2.1 Evaluation System Methodology

The construction of the evaluation system mainly starts from two aspects. The first is to follow the global biomedical innovation and development principles, and at the same time benchmark the leading cities in the foreign biomedical industry as research and study cases, then further study the experience of my country's existing biomedical industry development leading cities. The second is to integrate the global authoritative evaluation system map and judge the representative and independent index system, and finally builds this project through the combination of the two aspects. In the field of bio-medicine segmentation, the analysis of indicators in the subdivision field will reflect the differences in the field of bio-medicine in different cities.



Source: China Fortune Research Institute, China Securities, the annual reports of major biomedical companies, IQVIA analysis

The evaluation system starts with the development history of the global bio-medicine industry, to the transformation of the biomedical innovation model, and the formation of the global biomedical industry innovation development network, summarizing and analyzing the law of innovation and development of the biomedical industry.

P2 Summary: Looking at the law of innovation and development of the biomedical industry——technological development, perfection of the industrial chain, open innovation and change, and agglomeration development are the core driving factors.

Technological development

- Throughout the development history of the global biomedical industry, developed countries start with innovative patented technologies, while emerging countries have experienced the development process of copying and imitating industrial technologies.
- The digital economy centered on information technology has become a decisive factor in global economic development. In the future, new technology clusters led by biotechnology will also determine the competitive landscape of the global biomedical industry.

Improve the industrial chain

- At present, our biopharmaceutical industry is gradually upgrading from the low end of the industrial chain to the high end of the industrial chain. Innovative technologies will become a strong barrier to the development of the biomedical industry in the future.
- Originally researched patent drugs are basically concentrated in the hands of multinational pharmaceutical companies due to their high R&D investment, while domestic pharmaceutical companies focus on the development of generic drugs, especially the first generic drugs with policy advantages.

Open innovation

- Traditional biomedical innovation development model: a closed innovation mechanism with large biomedical companies as the core, a typical vertical integration innovation model.
- The globalization of knowledge and capital and the development of information technology have promoted the transformation of the innovative development model of the biomedical industry to "open".

Clustering of innovative companies

- The reform of the innovative development model of biomedical enterprises has promoted the formation and development of the innovative network of the biomedical industry.
- Multi-polarization is the trend of global innovation in the biomedical industry, and the quality of innovation has also become the key to innovation and development.

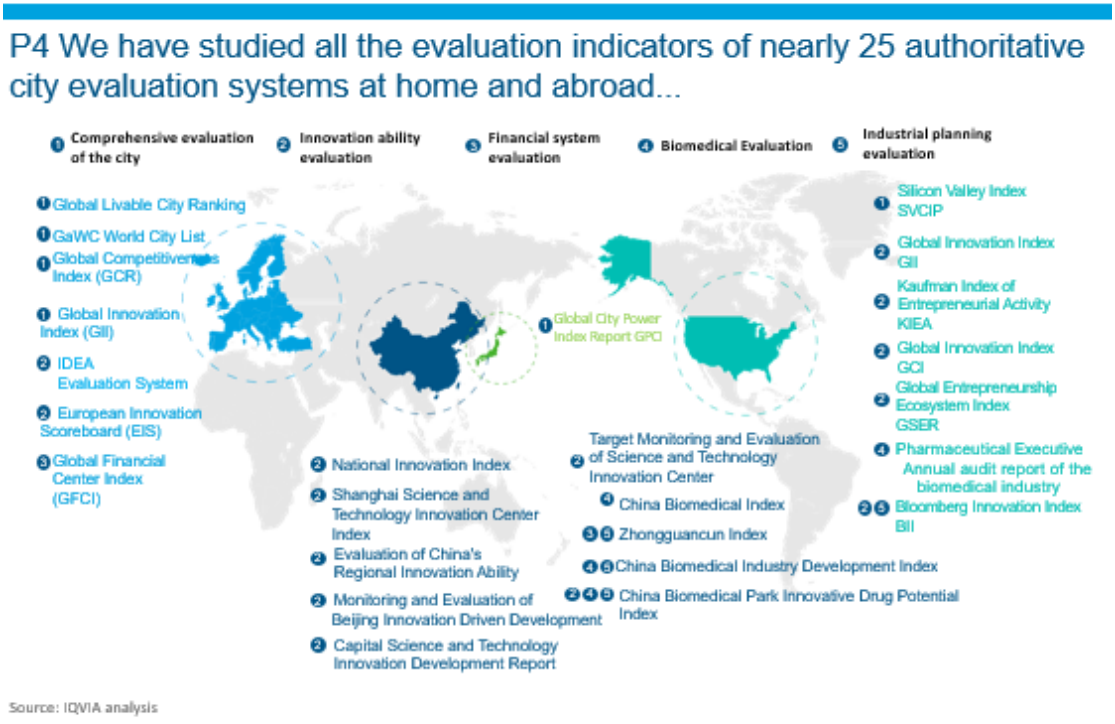
Source: China Fortune Research Institute, China Securities, the annual reports of major biomedical companies, IQVIA analysis

At the same time, through case studies of leading cities in the development of biomedical industry local and abroad, the key elements of the innovation and development of biomedical industry with cities as the core are summarized.

P3 Summarizing the development law of the biopharmaceutical industry and the experience of urban industrial development factors at home and abroad, the development of the bioindustry is mainly composed of six major elements, forming a "paper clip" system.

Source: China Fortune Research Institute, China Securities, the annual reports of major biomedical companies, IQVIA analysis

Also, the project team studied all the evaluation indicators of nearly 25 authoritative urban evaluation systems local and abroad and established an indicator database containing more than 400 indicators by integrating domestic and foreign indicator systems. Furthermore, the indicators were sorted and analyzed from the three aspects of urban economy, innovation environment, and bio-medicine. Then, they were further screened based on representativeness, applicability and accessibility, and finally selected 79 relevant indicators focusing on the innovation capability of urban bio-medicine.

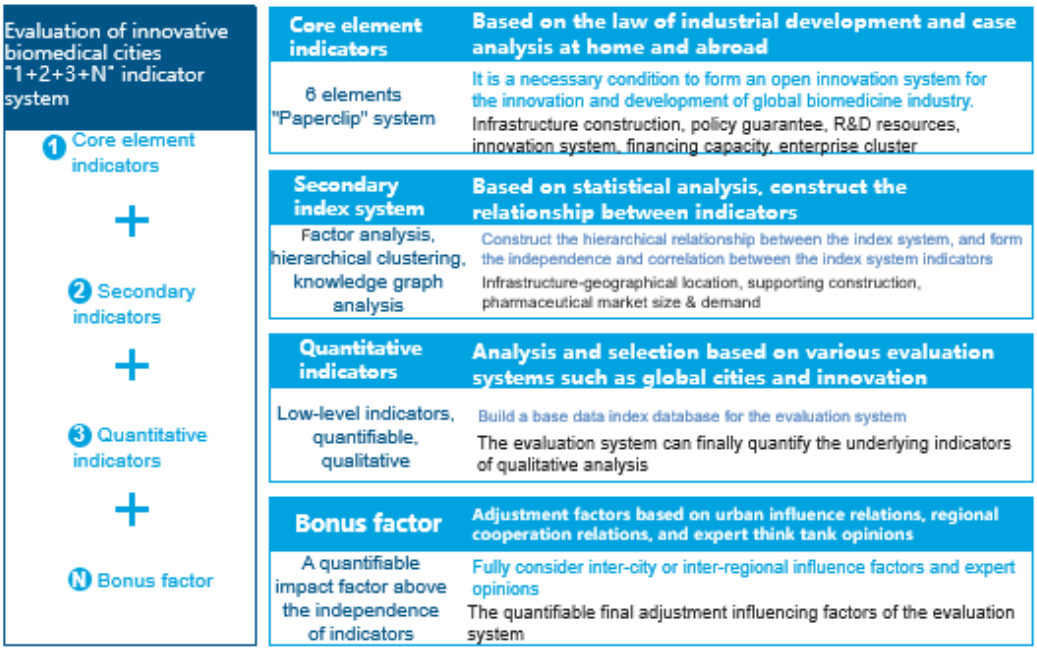


Source: IQVIA analysis

4.2.2 Main content of the evaluation system

The evaluation system consists of first-level indicators, second-level indicators, third-level indicators and bonus factors, forming a “1+2+3+N” indicator system for biomedical innovation city evaluation. The six major elements of biomedical innovation development are the core indicators. Level indicators are derived from the global authoritative city evaluation system and are screened based on relevance and accessibility. Finally, a secondary index system is constructed through factor analysis, hierarchical clustering, and knowledge map analysis. The "addition factor" will continue to expand the relevant development elements of the bio-medicine field and improve the evaluation system based on the independent expert opinions of the project.

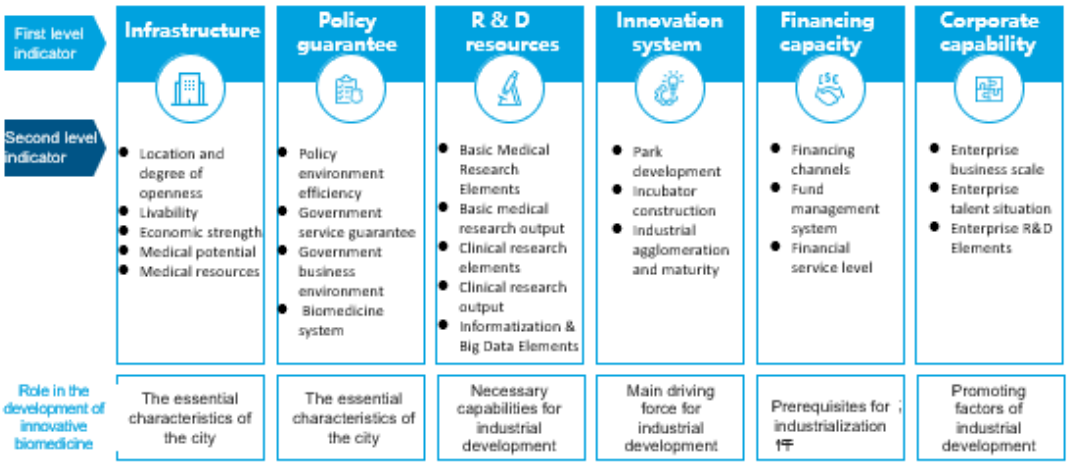
P5 Final evaluation system: Constructed into a 1+2+3+N index system with sufficient independence, traceability, and scalability for each index



Source: Desk study, IQVIA Knowledge Base

4.2.2.1 First-level and second-level indicators of the evaluation system

P6 summarizes the primary and secondary indicators as follows:



Sources: China Happiness Research Institute, Citic Jiantan Securities, annual reports of major biomedical enterprises,IQVIA analysis

4.2.2.2 The three-level indexes of the evaluation system

The three-level indexes of the evaluation system mainly include 79 indexes, which are listed under different first level and second-level indexes.

A. Infrastructure

P7 Three-level indicator breakdown and source-1

Infrastructure (20 items)

● Reflect the current situation of the industry ■ Reflect future potential

Location and degree of openness	unit	Whether to subdivide	Status/pot ential	Data source
Infrastructure conditions	index	×	●	"China's Provincial and Operating Environment Index Report"
Geographic connectivity	index	×	●	Data calculation
Developed cities (1/2 level cities, Hong Kong, Macao and Taiwan) radiation and technological interaction (+)	index	×	■	Data calculation
Number of high-tech international exhibitions held (+)	times	✓	●	Data calculation
City Livability	**unit**	**Whether to subdivide**	**Status/pot ential**	**Data source**
Livable degree of urban environment	index	×	■	Provincial statistical yearbooks, data calculations
Educational environment friendliness	index	×	■	Provincial statistical yearbooks, data calculations
Housing environment friendliness	index	×	■	Provincial statistical yearbooks, data calculations
Economic strength	**unit**	**Whether to subdivide**	**Status/pot ential**	**Data source**
City GDP	Billion	×	●	National Statistical Yearbook
Urban GDP growth	%	×	■	National Statistical Yearbook
Total permanent population	Million	×	●	National Statistical Yearbook
Disposable income of urban residents	yuan	×	●	National Statistical Yearbook
Medical potential	**unit**	**Whether to subdivide**	**Status/pot ential**	**Data source**
Number of hospital visits	person	×	■	Health Statistics Yearbook
Number of patients with major diseases/total number of regions	%	×	■	Health Statistics Yearbook
Biomedical market growth rate	%	✓	■	Data Integration
Mortality rate from top ten diseases	%	×	■	Data Integration
medical resources	**unit**	**Whether to subdivide**	**Status/pot ential**	**Data source**
Number of top three hospitals	a	×	●	Health Statistics Yearbook
Number of professional physicians (per thousand people)	%	×	●	Health Statistics Yearbook
Biomedical insurance expenditure	million	✓	●	CDE, IQVIA Statics
Per capita biomedical insurance expenditure	yuan	✓	●	Medical Insurance Database
Critical illness medical insurance covering innovative drugs & innovative medical insurance coverage (+)	a	×	■	Medical Insurance Database

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, IQVIA Knowledge Base

B. Policy guarantee

P8 Three-level indicator breakdown and source-2

Policy guarantee (15 items)

● Reflect the current situation of the industry ■ Reflect future potential

Government environmental efficiency	unit	Whether to subdivide	Status/pot ential	Data source
Government policy openness and fairness and government credit	index	×	●	Data calculation
Government administration burdens innovative enterprises	index	×	●	Data calculation

Government service guarantee	unit	Whether to subdivide	Status/pot ential	Data source
Intellectual property protection	index	×	●	China's Provincial Enterprise Environmental Index Report
The government's tax reduction or exemption for innovative enterprises as a percentage of the tax paid by enterprises	index	×	■	China Science and Technology Statistical Yearbook
The existence of policy enforcement departments	if	×	■	Provincial and municipal government reports
Policy implementation cycle	time span	×	■	Provincial and municipal government reports

Government business environment	unit	Whether to subdivide	Status/pot ential	Data source
Urban R&D expenditures invested in biomedicine/GDP	billion	✓	●	China Science and Technology Statistical Yearbook
Government Entrepreneurship Guidance Fund	billion	✓	●	China Science and Technology Statistical Yearbook
The complexity of tariffs	index	×	■	National Government Network
Trade tariff	%	×	■	National Government Network

Biomedicine system	unit	Whether to subdivide	Status/pot ential	Data source
Top-level design of related biomedical industry (+)	index	×	■	Provincial Science and Technology Department official website
Biological industry talent introduction policy	index	×	■	Provincial Science and Technology Department official website
The government encourages biomedicine development policy intensity	dex	✓	■	Provincial Science and Technology Department official website
Breakthrough biomedicine development policy	index	✓	■	Provincial Science and Technology Department official website
The local government provides the communication bridge between the enterprise and the relevant fields KOL/medical insurance bureau/CDE and other relevant national departments (+)	dex	✓	■	Expert evaluation, IQVIA desk research

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, Ai Kunwei Knowledge Base

C. R & D resources

P9 Three-level indicator breakdown and source-3

R&D resources (16 items)

● Reflect the current situation of the industry ■ Reflect future potential

Basic Medical Research Elements	unit	Whether to subdivide	Status/pot ential	data source
Number of State Key Laboratories and Engineering Technology Centers	a	✓	●	National Statistical Yearbook
University Biology Subject Rating	index	✓	●	Shanghairanking University Rankings in China
Biomedicine (national + provincial and ministerial level) talents	person	✓	■	General Office of the Ministry of Human Resources and Social Security

Basic medical research output	unit	Whether to subdivide	Status/pot ential	data source
National Biomedical Science and Technology Achievement Award	yuan	✓	●	China Science and Technology Statistical Yearbook
Number of granted biological patents	a	✓	●	CDE, Lilac Garden
Biomedical patent conversion rate	index	✓	●	expert interview
Supporting policy for the transformation of biotechnology achievements (+)	index	✓	■	Government websites

Basic medical research output	unit	Whether to subdivide	Status/pot ential	data source
Number of regional phase I clinical sites	a	✗	■	NMPA official website
Number of CRO/SMO clinical studies in the region	a	✗	●	IQVIA database
Influence of major regional researchers	index	✗	■	expert interview

Clinical research output	unit	Whether to subdivide	Status/pot ential	data source
Number of regional MRCTs	a	✓	●	CDE, Lilac Garden
Number of new biological drugs in Category 1 accepted by regional CDE	a	✓	●	CDE, Lilac Garden
Number of Type II and Type III Medical Devices on the Market	a	✓	●	CDE, IQVIA data

Informatization and big data elements	t	Whether to subdivide	Status/pot ential	data source
5G coverage	index	✗	■	Evaluation Report on China's Informatization Development Level
Application of Big Data in Medicine	index	✗	■	Evaluation Report on China's Informatization Development Level
Application of artificial intelligence tools	index	✗	■	Evaluation Report on China's Informatization Development Level

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, Ai Kunwei Knowledge Base

D. Innovation system

P10 Three-level indicator breakdown and source-4

Innovation system (11 items)

● Reflect the current situation of the industry ■ Reflect future potential

Park development	unit	Whether to subdivide	Status/pot ential	data source
Score of biomedical high-tech parks	index	×	●	China High-tech Industry Statistical Yearbook
Total revenue of biomedical high-tech parks	billion	×	●	IQVIA desk research
Biomedicine-related investment system and management maturity (+)	index	×	■	IQVIA desk research
Maturity of supporting construction (for example: training, public platform) (+)	a	×	■	IQVIA desk research

Incubator construction	unit	Whether to subdivide	Status/pot ential	data source
Number of biomedical incubators	a	✓	●	Zdatabase
Number of high-tech start-ups in biomedical incubators	a	✓	●	Zdatabase
Average financing amount of biomedical high-tech start-ups	billion	✓	●	Zdatabase

Industrial agglomeration and maturity	unit	Whether to subdivide	Status/pot ential	data source
Number of biomedical unicorn companies in the region	a	✓	●	Zdatabase
Clustering of upstream and downstream companies in the biological industry in the region	index	✓	■	IQVIA desk research
Cooperation degree of upstream and downstream companies in the biological industry in the region	index	✓	●	IQVIA desk research
Number of meetings in the biomedical industry (+)	a	×	●	IQVIA desk research

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, Ai Kunwei Knowledge Base

E. financing capacity

P11 Three-level indicator breakdown and source-5

Funding system (7 items)

● Reflect the current situation of the industry ■ Reflect future potential

Financing channels	unit	Whether to subdivide	Status/pot ential	data source
Number of biomedical enterprise funds	a	×	●	Zdatabase
Biomedical enterprise fund size	billion	×	●	Zdatabase
Diversified financing for biomedical companies	index	×	●	Data calculation

Fund management system	unit	Whether to subdivide	Status/pot ential	data source
Biomedicine exit internal rate of return	index	×	■	Data calculation
The number of investment exits from IPO accounted for/total investment exits (including early stage, entrepreneurial)	%	×	●	Data calculation

Financial service level	unit	Whether to subdivide	Status/pot ential	data source
Financial services and financing costs	index	×	■	China Provincial Enterprise Business Environment Index Report
Maturity of investment exit management mechanism (+)	index	×	■	Zdatabase

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, Ai Kunwei Knowledge Base

F. Corporate capability

P12 Three-level indicator breakdown and source-6

Enterprise capabilities (10 items)

● Reflect the current situation of the industry ■ Reflect future potential

Enterprise business scale	unit	Whether to subdivide	Status/pot ential	data source
Number of biological enterprises above designated size	a	✓	●	Data calculation
Biomedical enterprises main business revenue	billion	✓	●	Data calculation
Main business growth of biomedical companies	%	✓	■	Data calculation
Small and micro enterprise viability	index	✓	■	Expert interviews, IQVIA desk research

Enterprise talent situation	unit	Whether to subdivide	Status/pot ential	data source
Employment in biomedical companies	a	✓	●	Data collation
Number of R&D/employed persons in biomedical companies	%	✓	●	Data collation
Biomedical C-level management personnel background	index	✓	■	Expert interview

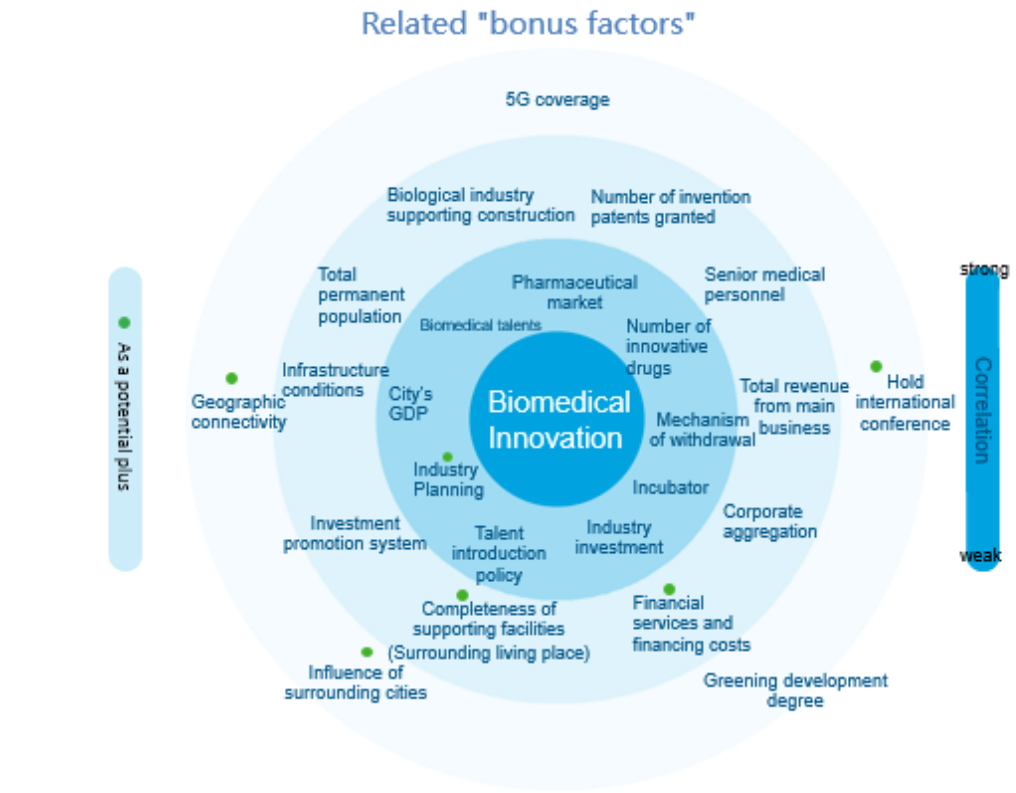
Enterprise R&D Elements	unit	Whether to subdivide	Status/pot ential	data source
Innovative product business revenue/total business revenue of biomedical companies	%	✓	●	Data collation
Biopharmaceutical company R&D investment/total business income	%	✓	■	Data collation
Enterprise production capacity and technological innovation	index	✓	■	Expert interviews, data compilation

Note: (+) indicators will be considered as bonus indicators

Source: Expert opinion, desk research, Ai Kunwei Knowledge Base

G. Finally, based on the accumulation of IQVIA related projects and expert resources, we will expand the "additional factors" related to the development of the medical and biological field.

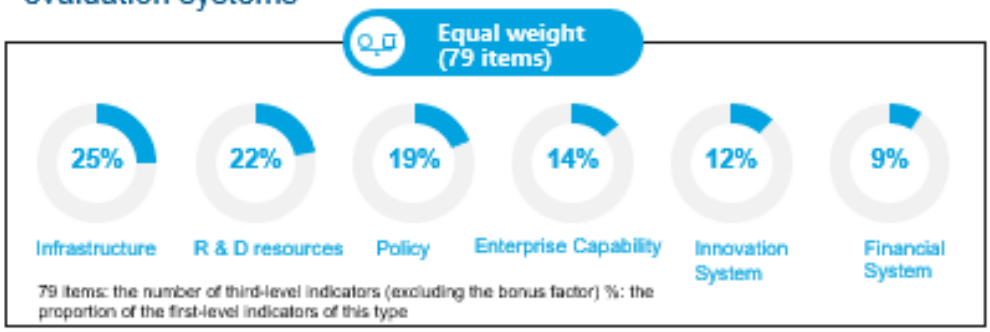
P13 Related bonus factors in the field of biomedicine



Source: Desk Research, IQVIA Knowledge Base

H. The scoring method of the evaluation system will be based on equal weights and joint bonus factors. The three-level indicators of the evaluation system include equal weights, and finally different weights will be given based on the bonus factors.

P14 Evaluation system scoring method —— will refer to the scoring method of equal weight combined with bonus factors commonly used in foreign evaluation systems



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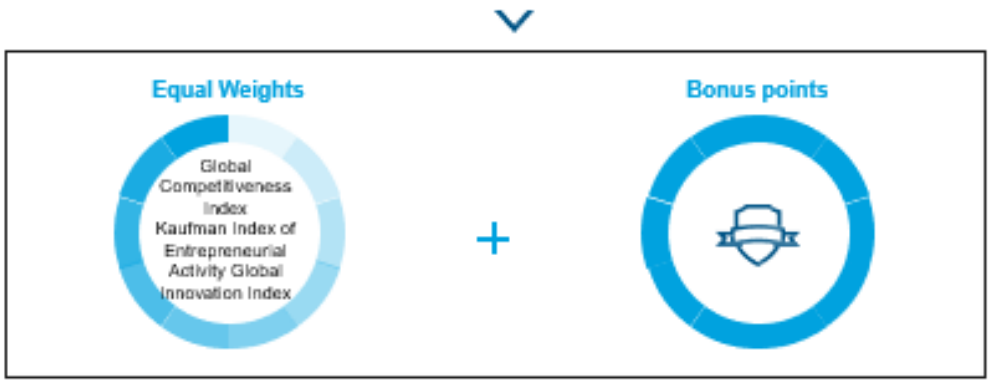
Bonus Pint

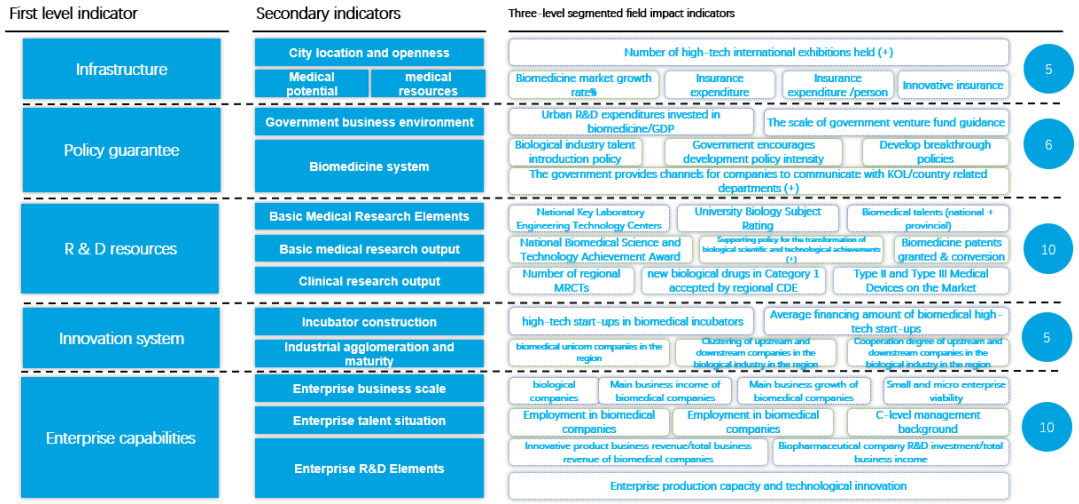
Level 1	Level 2	Level 3	Bonus
Infrastructure	City location and openness	Radiation and interaction of developed cities (class 1/2 cities, Hong Kong, Macao and Taiwan)	+
		Number of high-tech international exhibitions held	+
	medical resources	Major illness medical insurance covering innovative drugs & innovative medical insurance coverage	+
Policy	Biomedicine system	Top-level design of related biomedical industry	+
		bridge the gap, to lead the domain KOL/Medical Insurance Bureau/CDE	+
R&D	Basic medical research output	Supporting policy for the transformation of biological scientific and technological achievements	+
Innovation System	Park development	Biomedicine-related investment system and management maturity	+
		Maturity of supporting construction (such as training, public platform)	+
	Industrial agglomeration and maturity	Number of biomedical industry meetings	+
Financial System	Financial service level	The maturity of biomedical investment exit management mechanism	+



Source: IQVIA analysis

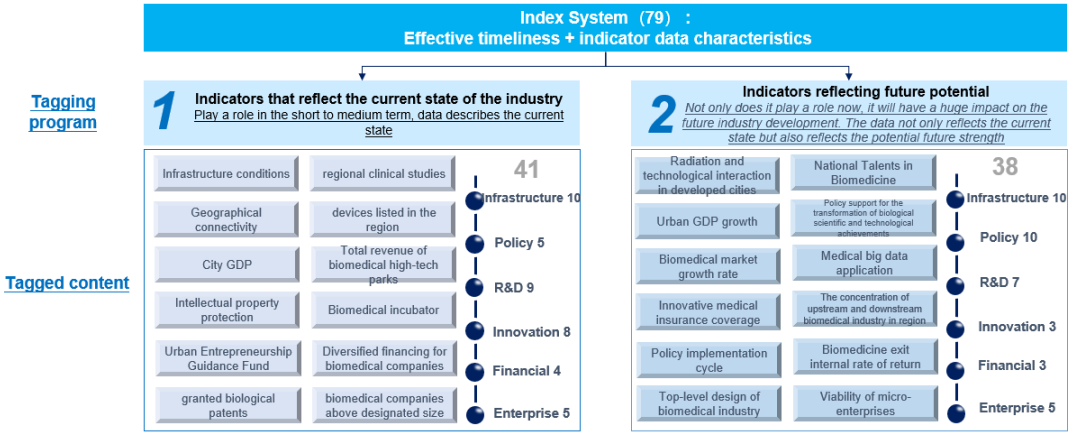
I. The evaluation system is differentiated based on whether there are differences in the subdivisions of the data collection sources. In the end, all the shortlisted cities will conduct a differential analysis through the overall evaluation and subdivision evaluation.

P15 In the evaluation system, there are a total of 36 impact indicators that reflect differences in subdivisions, accounting for 46% of all indicators



J. The evaluation system will also be labeled based on the content reflected by the index data, laying a foundation for the description of urban characteristics.

P16 Aiming at the three-level quantitative indicator system, we combine the timeliness of the indicators in the urban biomedical industry and the characteristics of indicator data, and perform labeling processing to lay the foundation for the description of urban characteristics

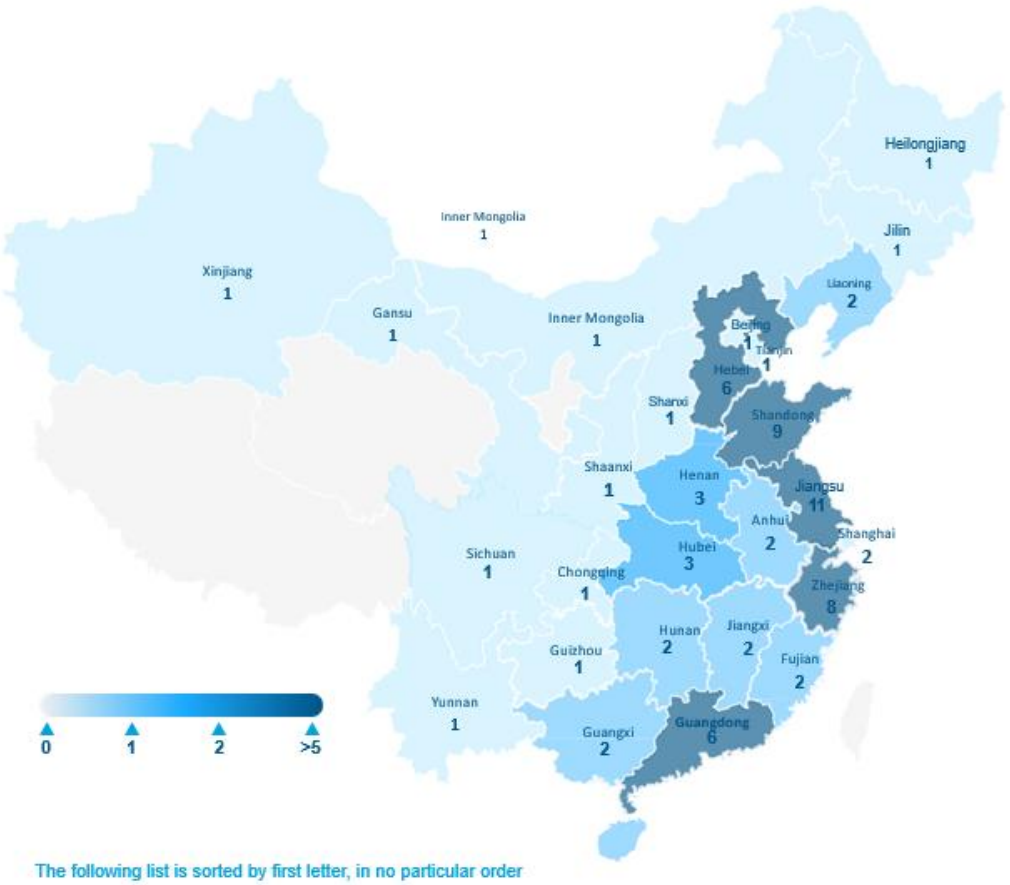


Source: Expert opinion, IQVIA analysis

4.2.2.3 Evaluation of selected cities

The selected cities in the evaluation will be preliminarily screened based on the three preferred conditions and the addition conditions. Priority conditions are cities with a GDP ranking within 100 and more than 100 cities with special advantageous policies. Priority conditions are two cities with innovative biomedical industrial parks. Preferred condition three: Cities that have introduced innovative bio-medicine development policies and are in key development areas. In addition, even though some of the top 100 provincial capital cities in the country's GDP can only meet priority conditions two or three, they could add it back based on their importance to regional industrial development.

P17 Selected 72 cities distributed in 28 provinces and cities



The following list is sorted by first letter, in no particular order

Anhui	Hefei	Wuhu									
Beijing	Beijing										
Chongqin g	Chongqing										
Fujian	Fuzhou	Xiamen									
Gansu	Lanzhou										
Guangdong	Dongguan	Foshan	Guangzhou	Shenzhen	Zhongshan	Zhuhai					
Guangxi	Liuzhou	Nanning									
Guizhou	Guiyang										
Hainan	Haikou	Qionghai									
Hebei	Baoding	Cangzhou	Handan	Langfang	Shijiazhuang	Tangshan					
Heilongjiang	Harbin										
Henan	Xinxiang	Xuchang	Zhengzhou								
Hubei	Wuhan										
Hunan	Yueyang	Changsha									
Jiangsu	Changzhou	Nanjing	Nantong	Suzhou	Taizhou	Wuxi	Xuzhou	Yancheng	Yangzhou	Zhenjiang	Lianyungang
Jiangxi	Ganzhou	Nanchang									
Jilin	Changchun										
Liaoning	Dalian	Shenyang									
Inner Mongo	Hohhot										
Shandong	Texas	Heze	Jinan	Liaocheng	Linyi	Qingdao	Weifang	Yantai	Zibo		
Shanghai	Shanghai										
Shaanxi	Xi'an										
Shanxi	Taiyuan										
Sichuan	Chengdu										
Tianjin	Tianjin										
Xinjiang	Urumqi										
Yunnan	Kunming										
Zhejiang	Hangzhou	Huzhou	Jiaxing	Jinhua	Ningbo	Shaoxing	Taizhou	Wenzhou			

4.3 CBCII——Overall Ranking

4.3.1 Overall city ranking

4.3.1.1 Top 20 cities index

Overall ranking	Region	City	Total index	Infrastructure	Policy guarantee	R&D resources	Innovation system	Financial system	Enterprise capabilities
1	Yangtze River Delta	Shanghai	60.0	10.2	10.9	11.3	5.3	5.3	8.0
2	Bohai Bay	Beijing	59.8	11.4	7.9	12.5	6.9	4.3	7.8
3	Greater Bay Area	Guangzhou	38.0	7.9	7.8	5.5	3.4	0.9	2.4
4	Yangtze River Delta	Suzhou	37.9	6.3	8.6	3.9	2.8	3.2	3.1
5	Yangtze River Delta	Hangzhou	37.0	7.4	7.0	5.4	2.6	3.4	2.2
6	Greater Bay Area	Shenzhen	36.7	6.9	8.3	3.3	1.9	3.2	3.1
7	Bohai Bay	Tianjin	35.7	6.7	9.3	2.8	3.0	1.9	5.0
8	Yangtze River Delta	Nanjing	34.2	6.5	7.2	6.2	1.8	2.6	1.9
9	southwest	Chengdu	34.1	7.4	6.3	3.8	2.4	1.6	2.6
10	Central China	Wuhan	33.5	7.4	8.2	3.2	2.2	0.7	4.5
11	southwest	Chongqing	33.2	7.2	7.3	3.7	2.9	2.0	2.5
12	Yangtze River Delta	Ningbo	30.1	6.2	7.5	2.8	0.9	1.2	2.4
13	Bohai Bay	Qingdao	26.0	6.3	6.1	2.9	1.2	2.1	2.0
14	northwest	Xi'an	25.3	6.1	6.6	3.0	0.8	0.7	2.1
15	Yangtze River Delta	Hefei	24.5	7.2	5.8	1.9	1.0	0.9	2.6
16	Central	Changsha	24.3	6.4	6.7	2.9	1.0	1.0	2.3

	China								
17	Yangtze River Delta	Taizhou	24.3	5.0	7.4	1.5	2.5	2.2	1.7
18	Yangtze River Delta	Wuxi	24.2	6.2	7.9	1.5	0.9	0.8	1.9
19	South China	Haikou	23.6	5.7	6.2	1.3	1.1	0.8	2.5
20	Bohai Bay	Jinan	23.3	6.5	6.0	2.7	1.6	0.6	1.9

4.3.1.2 Ranked 21-40 cities index

Overall ranking	Region	City	Total index	Infrastructure	Policy guarantee	R&D resources	Innovation system	Financial system	Enterprise capabilities
21	Yangtze River Delta	Xuzhou	23.2	4.3	7.3	2.9	0.5	0.8	1.4
22	southwest	Guiyang	22.9	5.9	7.6	1.5	0.6	0.6	1.8
23	East China	Fuzhou	22.7	5.8	6.3	2.1	0.1	0.6	1.9
24	Yangtze River Delta	Lianyungang	22.6	4.0	5.8	2.4	2.5	2.3	1.5
25	East China	Xiamen	22.1	5.2	5.0	2.8	0.4	0.6	2.0
26	southwest	Kunming	21.6	6.1	4.9	1.6	0.5	0.3	2.1
27	Bohai Bay	Shijiazhuang	21.6	6.0	5.0	2.5	2.1	0.7	1.3
28	Greater Bay Area	Zhuhai	21.3	5.0	6.0	1.7	0.3	0.8	1.6
29	northeast	Harbin	20.5	5.6	5.7	2.6	1.3	0.6	1.8
30	northeast	Changchun	20.5	5.9	4.8	3.0	1.0	0.7	2.2
31	Greater Bay Area	Foshan	20.4	6.5	6.7	0.7	1.1	0.4	1.0
32	East China	Nanchang	20.0	5.2	5.6	2.0	0.8	0.7	1.8
33	Yangtze	Changzhou							

	River Delta		20.0	5.4	5.5	3.0	0.8	0.8	1.5
34	Yangtze River Delta	Huzhou	20.0	5.3	7.6	1.2	0.1	0.8	1.0
35	South China	Liuzhou	19.3	4.7	6.6	0.4	0.0	1.0	1.5
36	Yangtze River Delta	Nantong	19.2	5.6	5.4	2.3	0.5	0.9	1.6
37	Bohai Bay	Shenyang	18.8	6.1	4.4	2.0	0.6	1.0	1.7
38	Yangtze River Delta	Jiaxing	18.7	6.1	5.5	2.2	0.0	0.9	1.1
39	South China	Nanning	18.6	4.6	6.7	1.3	0.7	1.0	1.4
40	Yangtze River Delta	Jinhua	18.5	6.5	6.0	1.9	0.0	0.8	1.2

4.3.1.3 Ranked 41-72 cities index

Overall ranking	Region	City	Total index	Infrastructure	Policy guarantee	R&D resources	Innovation system	Financial system	Enterprise capabilities
41	northwest	Lanzhou	18.4	4.9	4.9	1.6	0.6	0.2	1.2
42	East China	Yantai	18.3	5.3	5.4	1.6	0.8	0.6	1.6
43	Yangtze River Delta	Wenzhou	18.0	6.0	5.2	2.1	0.1	0.8	1.8
44	Bohai Bay	Dalian	17.8	6.1	3.0	2.0	0.1	0.9	1.6
45	Yangtze River Delta	Taizhou	17.2	5.6	5.8	2.0	0.8	0.9	1.1
46	Central China	Zhengzhou	17.1	6.3	4.6	1.9	0.1	0.4	1.8
47	Yangtze River Delta	Shaoxing	16.8	5.5	5.5	1.0	0.6	0.9	1.4
48	Central China	Xinxiang	16.8	4.5	4.9	2.4	0.0	0.4	1.6

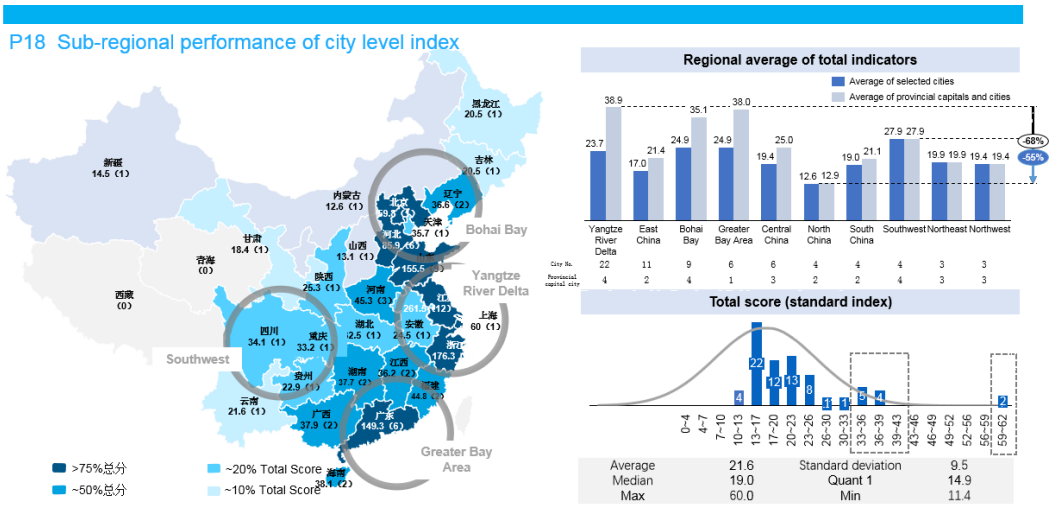
49	Greater Bay Area	Dongguan	16.7	5.0	6.0	0.5	0.8	0.4	1.0
50	East China	Linyi	16.4	4.9	4.8	1.1	0.3	0.6	1.7
51	Greater Bay Area	Zhongsha n	16.2	4.6	6.3	0.5	0.9	0.5	1.5
52	East China	Ganzhou	16.2	4.6	6.3	0.2	0.0	0.7	1.4
53	East China	Weifang	15.8	5.2	5.0	1.6	0.7	0.6	1.7
54	Yangtze River Delta	Yangzhou	15.0	4.8	5.4	1.1	0.4	0.7	1.5
55	East China	Zibo	14.7	4.9	5.2	1.5	0.8	0.6	1.6
56	northwes t	Urumqi	14.5	6.1	2.4	1.2	0.4	0.4	2.0
57	South China	Qionghai	14.5	3.3	4.5	1.1	0.0	0.8	1.8
58	Yangtze River Delta	Yancheng	14.2	3.9	5.1	2.1	0.0	0.8	1.3
59	East China	Texas	14.1	3.9	4.5	1.4	0.3	0.6	1.5
60	East China	Heze	13.9	4.8	4.7	1.4	0.0	0.6	1.5
61	Bohai Bay	Baoding	13.7	5.1	3.7	1.2	0.1	0.6	1.0
62	Yangtze River Delta	Zhenjiang	13.5	4.2	5.1	2.1	0.0	0.8	1.2
63	Central China	Yueyang	13.4	4.2	4.3	1.1	0.2	0.4	1.2
64	Bohai Bay	Tangshan	13.3	5.5	3.7	1.1	0.0	0.6	1.3
65	North China	Langfang	13.3	4.7	3.9	1.1	0.0	0.6	0.9
66	Yangtze River Delta	Wuhu	13.2	4.7	5.3	0.2	0.0	0.9	0.9
67	North China	Taiyuan	13.1	5.7	2.5	1.5	0.0	0.1	2.3
68	East China	Liaocheng	13.0	3.9	4.7	1.4	0.0	0.6	1.4

69	North China	Hohhot	12.6	4.0	2.9	0.5	0.2	0.7	1.3
70	Bohai Bay	Cangzhou	12.5	4.8	3.3	1.1	0.6	0.6	1.0
71	North China	Handan	11.5	4.8	3.6	1.4	0.0	0.6	1.0
72	Central China	Xuchang	11.4	4.6	3.7	1.1	0.0	0.4	1.5

4.3.2 Regional performance

The selected 72 cities are distributed in 10 major regions of the country, and the city density is ranked as the Yangtze River Delta, East China, Bohai Rim, Greater Bay Area, Central China, Southwest China, South China, North China, Northeast China, and Northwest China. The four cities in the southwestern region have the highest average score in the region, which is 55% different from the lowest average score in North China. If only the regional average is carried out in the capital cities of the municipalities directly under the Central Government, the average index of the Yangtze River Delta is the highest, and the Greater Bay Area ranks second, followed by the Bohai Rim. Among them, North China is still the lowest, which is 68% different from the highest in the Yangtze Delta.

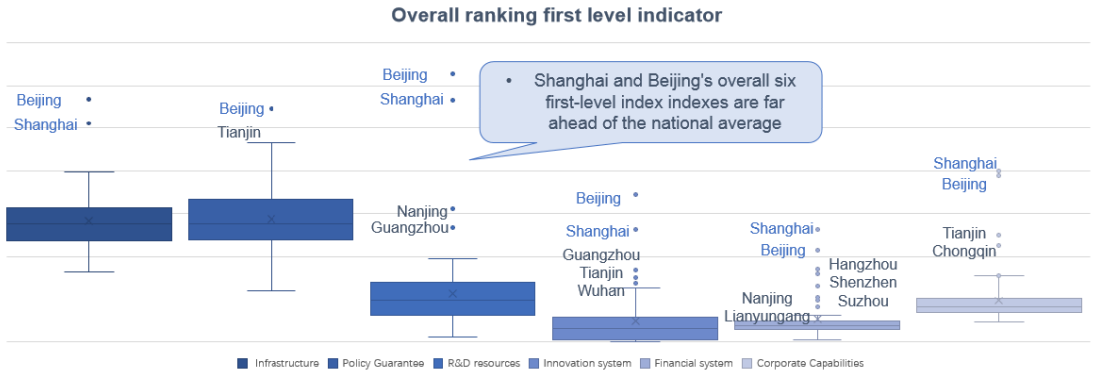
The selected 72 city indexes are arranged according to the normal distribution. The two cities of Beijing and Shanghai far exceed other cities. The subsequent cities basically form a normal distribution, but there is still a lot of room for upwards in the index.



4.3.3 Urban comparison analysis

Judging from the distribution of the first-level index indexes of 72 cities, except for Shanghai and Beijing, which are far ahead of each index, the indexes of other cities have initially shown a normal distribution. Also, the indexes vary greatly among cities.

P19 Sorted according to the city's first-level index . The big gap in the city index is mainly due to R&D resources, innovation system, financial system and corporate capabilities



- Overall, comparing the first-level indicators, it is not difficult to see that the development of national infrastructure and policy guarantees is relatively comprehensive, and there is an initial trend of "normal distribution", and the gap between cities is average
- As for the accumulation of R&D resources, the construction of innovation systems, capital systems and corporate capabilities, the development of cities across the country varies.
- Except for Shanghai and Beijing, other cities ranked high in the index have their own advantages in different fields

4.3.3.1 Comparative analysis of urban infrastructure

The first-level indicator city infrastructure mainly includes three categories: city location and degree of openness and livability, city economic strength, medical potential and medical resources. Different types of indicators have different representative meanings to measure the soft and hard conditions of the region's basic industrial innovation and entrepreneurship.

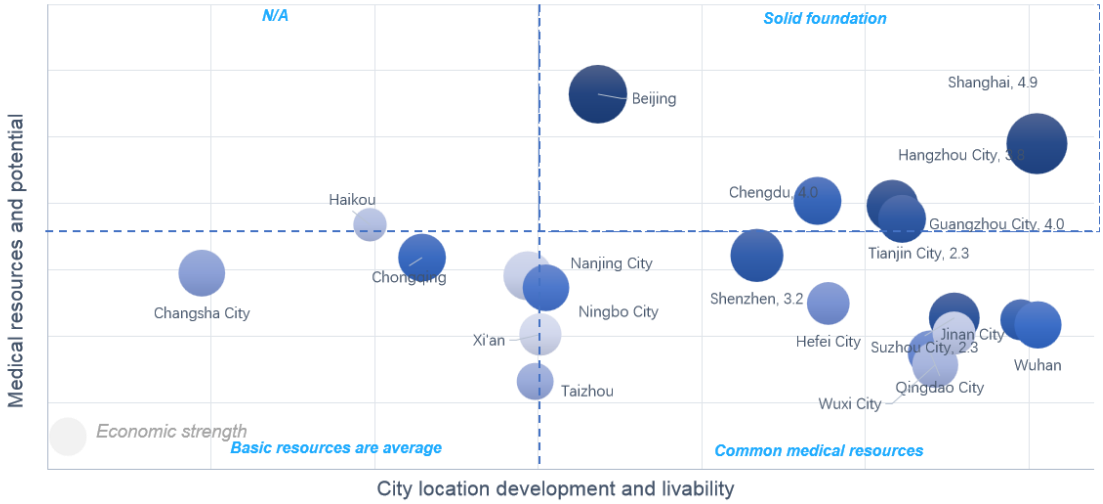
Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
City location and openness	Infrastructure conditions: sewage treatment rate, electricity consumption of the whole society, total mileage of domestic roads	index	+	Measure the basic hardware conditions for regional innovation and entrepreneurship, including hydropower, transportation, etc.
City location and openness	Geographical connectivity: distance to surrounding core cities	index	-	Measure the degree of regional openness
City location and openness	Developed cities (1/2 cities, Hong Kong, Macao and Taiwan) radiation and technological interaction (+)	Total score: 1	+	Measure the degree of regional openness
City Livability	Number of high-tech international exhibitions held (+)	Total score: 1	+	Measure the holding situation and capacity of regional high-tech conventions and exhibitions, and reflect the capacity and capacity of convention and exhibition centers in the region
City Livability	Livable degree of urban environment: green coverage, precipitation, temperature	index	+	Measure the livability of the area, including temperature, precipitation, greening degree, etc.
City Livability	Educational environment friendliness: the number of colleges and universities, the number of students per teacher in colleges, the number of secondary schools, the number of	index	+	Measure whether regional education is attractive to talents, including whether primary and secondary education is perfect

	schools per teacher in secondary schools, the number of primary schools, the number of schools per teacher in elementary schools			
City Livability	Housing environment friendliness: average price and rent of new buildings	index	-	Measure whether the regional housing burden will affect the introduction of talents, including housing prices and housing burdens
City economic strength	City GDP	Billion	+	Measure regional economic strength
City economic strength	Urban GDP growth	%	+	Measure regional economic strength
City economic strength	Total permanent population	Million	+	Measuring the regional labor force
City economic strength	Disposable income of urban residents	yuan	+	Measuring the quality of life of residents
Medical potential	Number of hospital visits	Person times	+	Measuring the level of basic medical care
Medical potential	Number of patients with major diseases/total number of regions	%	+	Measure basic medical research level and medical basic maturity
Medical potential	Biomedicine market growth rate% (market growth rate calculated based on the total assets of the pharmaceutical industry)	%	+	Measure the scale and development potential of the regional biological market
Medical potential	Death rate from top ten diseases%	%	+	Measuring the potential and needs of regional biomedical patients
medical resources	Number of top three hospitals	A	+	Measure basic medical research level and medical basic maturity
medical resources	The number of professional physicians (per thousand people)	%	+	Measure the basic development conditions of regional medicine and biology
medical resources	Biomedical insurance expenditure	Billion	+	Measure the support of the regional government for the later commercialization of the overall medical biology
medical resources	Per capita biomedical insurance expenditure	yuan	+	Measure the support of the regional government for the later commercialization of the overall medical biology
medical resources	Critical illness medical insurance covering innovative drugs & innovative medical insurance coverage (+)	Total score: 1	+	Measure regional government's support for overall medical and biological innovation

Through detailed analysis of the basic conditions of 72 cities, we found the following characteristics.

A. The medical resources and potential index of each city always maintain a positive correlation with basic conditions such as the openness and livability of the city. The general medical resources and potential of cities with excellent basic conditions are also developed. This is closely related to the number of urban population and GDP.

P20 Through the analysis of urban infrastructure, medical resources and urban basic conditions maintain a positive correlation



B. The radiation of the location of a city can help promote the development of urban industries and form a development pattern that leverages each other in a specific area. Therefore, it is one of the important indicators in the urban industry innovation index.

P21 The radiation of the city helps to form a development pattern in the region that leverages and promotes each other

Yangtze River Delta City Group

- The city cluster with the most dynamic economy and the most reasonable urban hierarchical structure in China
- Six major cities join the GDP trillion club
- Five metropolitan areas will be built with core cities as Nanjing, Hangzhou, Hefei, Suzhou, Wuxi, and Ningbo
- Core city planning, economic efficiency and world-class city clusters are far behind

Greater Bay Area City Group

- Corporate with Hong Kong and Macao to create a world-class bay area and a world-class city cluster;
- The manufacturing level is developed, and it is committed to building a pharmaceutical technology, biological industry innovation center and an advanced modern service industry base;
- Except for Shenzhen, cities in the Pearl River Delta are dominated by low-end manufacturing industries, and independent innovation capabilities need to be improved

Beijing-Tianjin-Hebei Urban Agglomeration

- The overall innovation level is in a leading position in the country, and the market value of A+H-share listed companies is 31.4 trillion yuan;
- In recent years, the top-level design has been continuously strengthened to create a world-class city cluster with the capital as the core;
- In the future, it will focus on the direction of "high-end manufacturing + technological innovation";

Chengyu City Group

- Cultivate the "fourth pole" of China's economic growth;
- The division of labor between the two places is not sufficient, and competition is greater than cooperation

C. As an important channel for the dissemination of industrial knowledge and technology, the biomedical innovation exchange platform is still in its preliminary development and maturity across the country. Its influence on industrial innovation and development can be expected. The current platform for medical innovation exchanges is mainly based on various innovation exchange conferences.

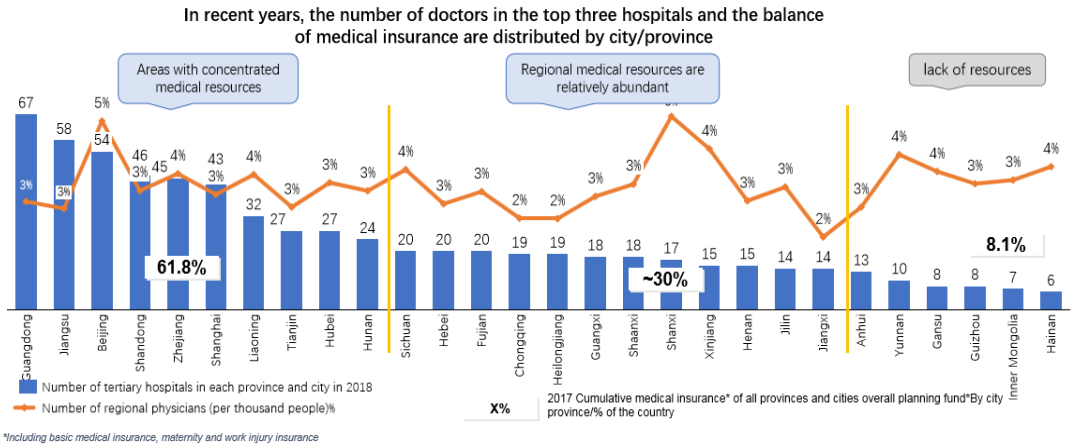
P22 Regional biomedical innovation exchange conferences in recent years (including domestic and international conferences)

. Meeting information source Dingxiangyuan (X) Number of representative meetings (including domestic and international meetings)

D. In the urban infrastructure construction, the basic conditions, the degree of livability, and the total GDP are relatively small due to the preliminary screening, while the medical capabilities and resources have opened the city's innovation index to a greater extent.

P23 In the urban infrastructure construction, the basic conditions, the degree of livability, and the total GDP are relatively small due to the preliminary screening, while the medical capabilities and resources have opened up the city's innovation index to a greater extent.

The coverage of professional physicians is relatively average. At present, cities with strong medical capabilities have a relatively high concentration of 3A hospitals. The top 10 provinces and cities have accounted for >50% of the 3rd hospitals in the country. The cumulative balance of the 2017 overall fund is relatively abundant , More than 60%, abundant basic medical resources



*Including basic medical insurance, maternity and work injury insurance

4.3.3.2 Comparative Analysis of Urban Policy Guarantee

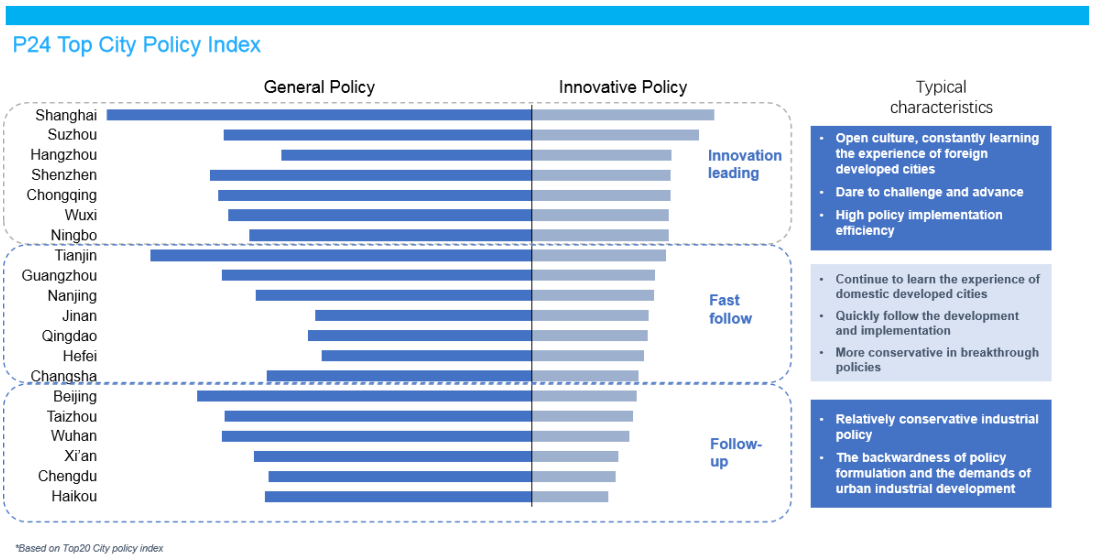
The first-level indicator city policy guarantee mainly includes four categories: government environmental efficiency, government service guarantee, government business environment, and bio-medicine system in order to measure the city government's support for industrial innovation, efficiency, guarantee and overall planning.

Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
Government environmental efficiency	Policy system openness and fairness and government credit	Total score: 5	+	Measure the openness and transparency of the policy system, the fairness of administrative law enforcement, the fairness of enterprises and local protectionism
Government environmental efficiency	Government administration burdens innovative enterprises	Total score: 5	+	Measure the basic development conditions of regional innovation
Government service guarantee	Intellectual property protection	Total score: 6	+	Measure the basic development conditions of the regional innovation environment
Government service guarantee	The government's tax reduction or exemption for innovative companies as a percentage of the company's tax payment	Total score: 2	+	Measure the basic hardware conditions of regional innovation and entrepreneurship
Government service guarantee	The existence of policy enforcement departments	Total score: 5	+	Measure whether the implementation of regional government policies is in place
Policy service guarantee	Policy implementation cycle	Total score: 5	+	Measure whether the implementation of regional government policies is in place
Government business environment	Urban R&D expenditures invested in biomedicine/GDP	%	+	Measure regional government's ability to develop biomedicine
Government business environment	Government Entrepreneurship Guidance Fund Scale	Ranking (100)	+	Measure the local government's support for innovation and entrepreneurship
Government business environment	The complexity of tariffs	Total score: 5	+	Measure the degree of regional openness
Government business environment	Trade tariff%	%	-	Measure the degree of regional openness
Biomedicine system	Top-level design of related biomedical industry (+)	Total score: 1	+	Measure regional support for the development of biomedicine
Biomedicine system	Biological industry talent introduction policy	Total score: 3	+	Measure the attractiveness of relevant innovative talents in the region and evaluate the potential of biomedicine research and

				development
Biomedicine system	The government encourages biomedicine development policy intensity	Total score: 8	+	Measure regional support for the development of biomedicine
Biomedicine system	Breakthrough biomedicine development policy	Total score: 2	+	Measure regional support for the development of biomedicine
Biomedicine system	The local government provides a communication bridge between the enterprise and related fields KOL/medical insurance bureau/CDE and other relevant national departments (+)	index	+	Measure whether the region has sufficient capacity and determination to act as a communication bridge between enterprises and national departments, and make certain contributions to local biomedical companies

Through a detailed analysis of 72 cities' policy guarantees, we found the following characteristics.

A. Through investigations in multiple cities, we found that most cities are actively promoting regional bio-industry innovation and development policies, and the promotion and implementation efficiency is relatively high, including actively supporting the innovative development of the bio-industry, building service platforms, increasing capital investment, and accelerating Promulgate various talent and financing incentive policies. At the same time, various incentive policies are in place and the efficiency is excellent. Some regions with higher willingness have begun to actively promote the process of industrial commercialization. Different cities have adopted different strategies in terms of breakthrough industrial policies, and some cities have demonstrated a leading spirit in innovation policies.



B. Policy-led provinces and cities have their own characteristics in advancing "breakthrough innovative medical policies".

- Shanghai issued the "Several Opinions on Promoting the High-quality Development of the City's Health Service Industry and Accelerating the Construction of a First-class Medical

Center City" to support the construction of a stem cell production center, a stem cell quality inspection service platform, a national stem cell resource bank, and a national stem cell clinical research in the Shanghai Pilot Free Trade Zone Functional platform.

- Zhejiang supports the application of new technologies in the field of Bio-medicine. Support the transformation and application of new medical technologies such as biological 3D printing technology, precision medicine, drug chips (digital medicine) and artificial intelligence. For technology application projects that have landed in our city, a subsidy of no more than 10% of the actual investment and a maximum of 20 million yuan will be given.
- Suzhou and Wuxi in Jiangsu: For outstanding projects that use industrial Internet artificial intelligence and other technologies to carry out technological transformation of existing production facilities and process equipment. The maximum subsidy will be 15% of the project investment, and the maximum annual subsidy for a single enterprise will not exceed 5 million yuan.
- Shandong provides a one-time subsidy for the evaluation, audit, and legal advisory expenses incurred in overseas acquisitions and mergers of enterprises. The maximum subsidy is 15% of the project investment, and the maximum annual subsidy for a single enterprise is not more than 5 million yuan.
- Guangdong will provide three-year rent subsidies for newly introduced projects, with all kinds of support funds. Biological products enterprises shall not exceed 20 million yuan, and medical device enterprises shall not exceed 10 million yuan

C. However, due to the lack of top-level design, the actual output characteristics of the local government are not obvious, and the industrial planning is seriously homogenized, lacking the market transformation ability in the later stage.

P25 Analysis of policy coverage in selected cities

The overall lack of a complete top-level planning, serious homogeneity between cities and cities, and the characteristics are not obvious

- Although the policies are strong in most regions, **the policy industry chain is not comprehensive,** resulting in policy effects that are not up to expectations with huge investment
- Some **areas lack long-term goals** for the introduction of projects. After the introduction, the homogeneity of the industrial planning is serious, and industry competition in the same city occurs.

"When we talked about the project, we focused more on the project itself, **and didn't consider what the introduction of this project would do to my entire development zone.**"

"Currently, the application is strong, (other links are not in place). In the future, we will build a complete closed chain of production, learning, teaching, research, and sales, otherwise the future development will be very limited."

2017-2020 Evaluation of Policy Coverage in Different Regions by Detailed Rules

★★★ Strong policy
★ Weak policy

	City	Top-level planning	Pre-clinical	Clinical	MD registration	Product/ MAH	Project introduction	Financial Service	Talents	Plants
1	Shanghai	★★★	★★★	★★★	★★	★★★	★★	★★★	★★★	★★
2	Tianjin	★★★	★★★	★★★	★★★	-	★	★★★	★★★	★★★
	Nanjing	★	-	★★★	★★★	★★★	-	★★★	★★	★★
	Wuhan	★★	★★★	★★★	★★★	★★	-	★★★	★★	★
3	Haikou	-	-	-	-	★★	-	★★★	★★★	★★★
	Nanjing	-	-	-	★★★	-	-	★★★	★★	★★
	Hefei	-	★★	★★	-	★★★	-	★★	-	-

1	Strong policy and comprehensive coverage	• Good top-level design, comprehensive policy coverage, no shortcomings in policy incentives • The industry has the best development, such as Beijing and Shanghai, with a small number
2	Strong policy, covering incomplete areas	• Policy coverage is not comprehensive, and there are shortcomings in policy incentives • Mainly because of the strong biological industry, but not the top cities
3	Areas with missing policy coverage	• Incentive policies are strong, but there are many lack of coverage, and policy incentives have obvious shortcomings

4.3.3.3 Comparative analysis of urban research resources

The first-level indicator city research resources mainly include four categories: basic medical research elements, basic medical research output, clinical research elements, clinical research output, informatization and big data elements, in order to measure the city's biomedical innovation research and development capabilities, human resources Reserves, biomedical clinical research capabilities, information development capabilities, and innovation development efficiency potential.

Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
Basic Medical Research Elements	Number of State Key Laboratories and Engineering Technology Centers	#	+	Measure regional government's ability to develop biomedicine
Basic Medical Research Elements	University Biology Subject Rating	#	+	Measure regional government's ability to develop biomedicine
Basic Medical Research Elements	Biomedical (national + provincial) talents	#	+	Measure the reserve of human resources in regional medical and biological R&D
Basic medical research output	National Biomedical Science and Technology Achievement Award	¥	+	Measure regional government's ability to develop biomedicine
Basic medical research output	Biomedical patents granted	#	+	Measure regional doctors' biomedical innovation capabilities
Basic medical research output	Biomedical patent conversion rate	#	+	Measure regional doctors' biomedical innovation capabilities
Basic medical research output	Supporting policy for the transformation of biological scientific and technological achievements (+)	Total score: 1	+	Measure regional support for the transformation of biomedical achievements
Clinical research elements	Number of regional phase I clinical sites	#	+	Measure the capacity of clinical research in the region
Clinical research elements	Number of CRO/SMO clinical studies in the region	#	+	Measure the current level of clinical research in the region
Clinical research elements	Influence of major regional researchers	Total score: 113	+	Measure the capacity of clinical research in the region
Clinical research output	The number of regional MRCTs (according to the sponsor's location, some sponsors have multiple locations, so there is 0.5)	#	+	Measure the comprehensive scientific research level of basic medical care
Clinical	Number of new biological drugs in	#	+	Measure regional biological innovation and

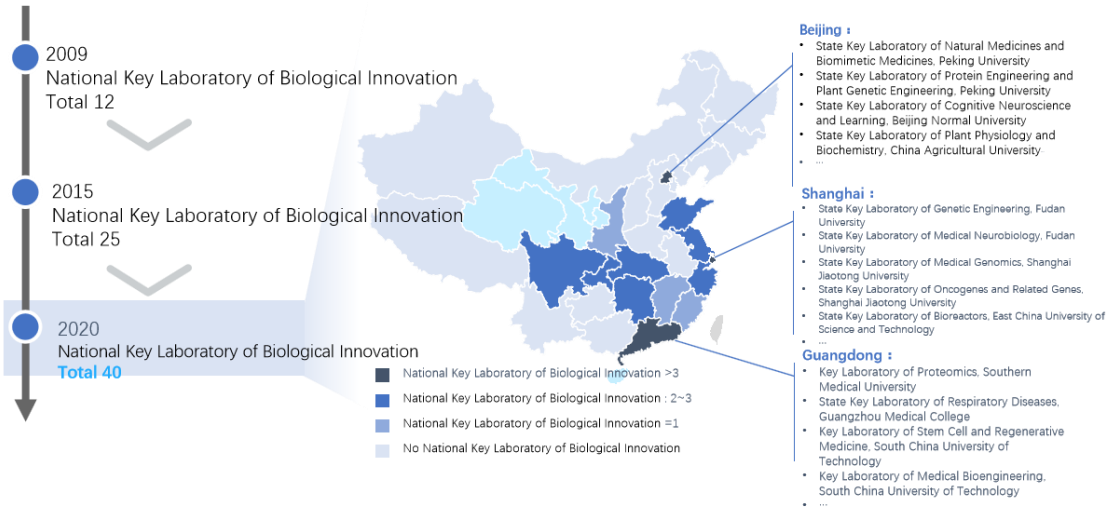
research output	Category 1 accepted by regional CDE			basic scientific research capabilities
Clinical research output	Number of Type II and Type III Medical Devices on the Market	#	+	Measure regional biological basic research and development capabilities
Informatization and big data elements	Application of Big Data in Medicine	Total score: 10	+	Measure regional informatization development capacity and innovation development efficiency potential
Informatization and big data elements	Artificial intelligence (AI) tool application	Total score: 100	+	Measure regional informatization development capacity and biomedicine development efficiency potential

Through the detailed analysis of r & D resources in 72 cities, we find the following characteristics.

A. In recent years, the number of national key biological innovation laboratories has been increasing rapidly, which is mainly concentrated in Beijing, Shanghai, Guangdong and other developed areas.

B. At present, the corresponding cities in China have begun to have a strong biomedical talent.

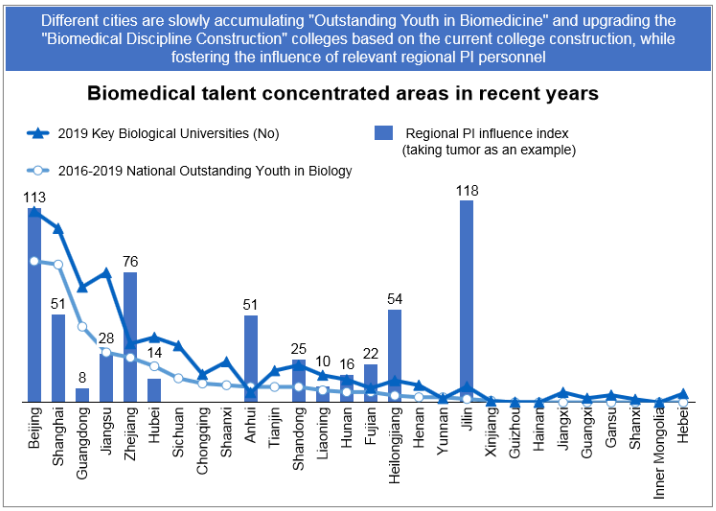
P26 Distribution of national key biological laboratories by province



The potential of the future can be expected.

P27 Biomedical talents in various provinces and cities

Different cities are slowly accumulating "Outstanding Youth in Biomedicine" and upgrading the "Biomedical Discipline Construction" colleges based on the current college construction, while fostering the influence of relevant regional PI personnel



Regional PI influential people (take tumor as an example):

Cheng Ying (Jilin Provincial Tumor Hospital); Qin Shukui (The 81st Hospital of the Chinese People's Liberation Army); Shi Yuankai (Chinese Academy of Medical Sciences Tumor Hospital); Li Jin (Shanghai Oriental Hospital); Lu Shun (Shanghai Chest Hospital), etc.

Key College of Biology:

Tsinghua University; Peking University; Fudan University; Sun Yat-sen University; Peking Union Medical College; Shanghai Jiao Tong University; Wuhan University; Zhejiang University; South China Agricultural University; Huazhong Agricultural University; University of Science and Technology of China; Nanjing University; Shandong University; Lanzhou University; China Agricultural University; Northeast Agricultural University; Sichuan University; Tongji University

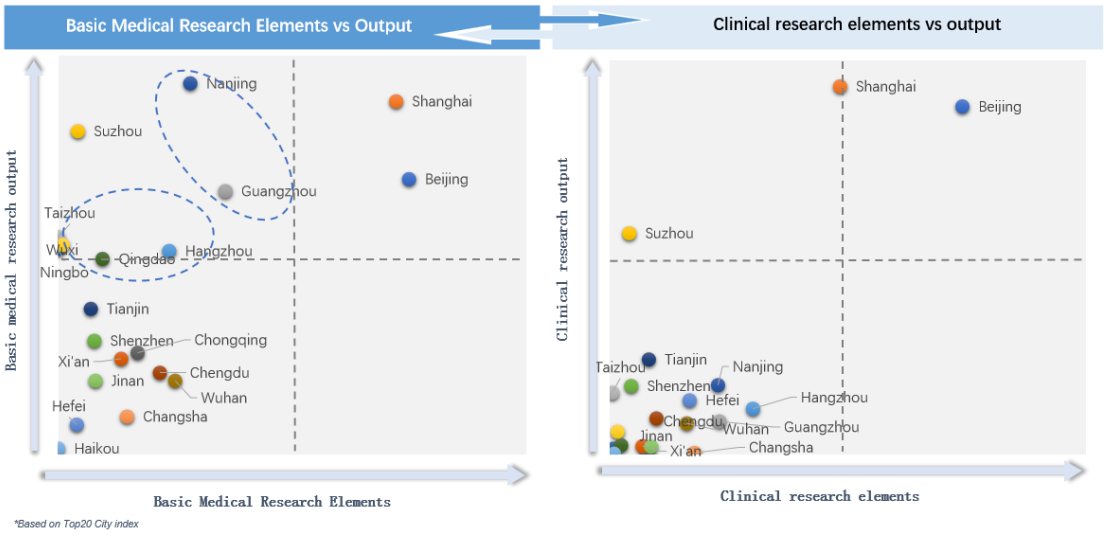
Biomass accumulation (partial):

Under the age of 40, research results are widely recognized, with more than 3 years of postdoctoral research experience in well-known universities and companies

Zhou Jin	Beijing	Myocardial and nerve tissue engineering
Zhong Bo	Wuhan	Viral immunology
Zhao Wei	Jinan City	Virus infection and host innate immunity
Zhao Han	Jinan City	Polycystic Ovary Syndrome
Zeng Gucheng	Guangzhou City	The immune regulation mechanism of tuberculosis
...	...	...

C. At the same time, we found that the translational medicine capabilities of each city are relatively weak. There is no perfect platform, which is a weak link in the overall research and development capabilities, resulting in the overall transformational capabilities of the city at the preliminary stage. Except for Beijing and Shanghai, there is a large gap between basic research and clinical research in various cities, and the gap between basic research and clinical research needs to be resolved.

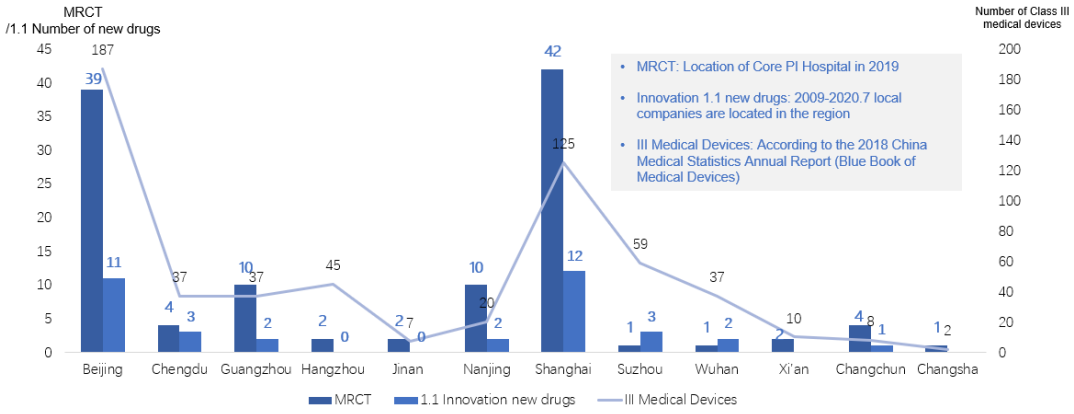
P28 Comparative analysis of basic research and clinical research elements of top cities



*Based on Top20 City index

D. From the perspective of clinical research and output, there is a positive correlation between the number of new drugs listed in the city and the number of medical devices listed in the MRCT core PI institute.

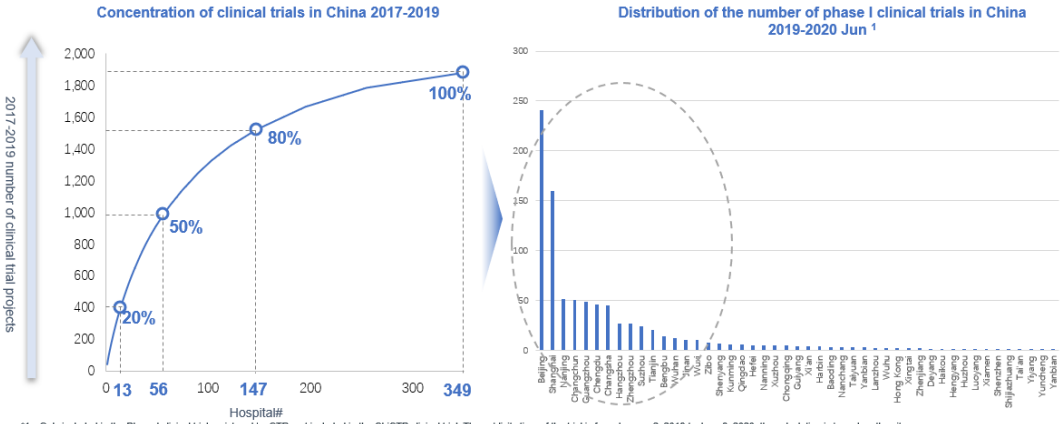
P29 Clinical research output of key provinces and cities in recent years



E. With the promotion and implementation of GCP, the number of clinical trial centers in each city is initially increasing. At present, clinical centers across the country are slowly expanding from core cities to the periphery. With the development of leading CRO and SMO, the current number of clinical research personnel is more in line with the overall potential distribution of the bio-medicine market, among which the talent pool of basic medical research in bio-medicine is the core difference.

P30 The concentration of clinical trial centers and the distribution of phase I clinical trial centers

With the development of leading CRO and SMO, the number of researchers is more in line with the overall biomedical market potential distribution, and the basic medical research talent reserve of biomedicine is the core difference



*1: Only included in the Phase I clinical trial registered by CTR, not included in the ChiCTR clinical trial. The publicity time of the trial is from January 2, 2019 to June 8, 2020; the calculation is based on the city where the trial site is located, if the trial If it is conducted in two cities at the same time, it will be counted once in both cities; Source: Medical Rubik's Cube database, desk research, expert interview, IQVIA analysis

P31 Undertake global tumor trials and domestic tumor trial PI rankings in 2019

2019 PI ranking of global tumor trials (in terms of number)

Key PI	Hospital Name	City	MRCT #
Cheng Ying	Jilin Provincial Tumor Hospital	Changchun	21
Qin Shukui	The 81st Hospital of the Chinese People's Liberation Army	Nanjing	14
Zhou Jianying	First Affiliated Hospital of Zhejiang University School of Medicine	Hangzhou	12
Fang Jian	Peking University Cancer Hospital	Beijing	11
Bai Yuxian	The Affiliated Tumor Hospital of Harbin Medical University	Harbin	10
Cui Jiuwei	The First Hospital of Jilin University	Changchun	10
Li Wei	The First Hospital of Jilin University	Changchun	10
Lu Shun	Shanghai Chest Hospital	Shanghai	10
Xu Binghe	Chinese Academy of Medical Sciences Cancer Hospital	Beijing	10
Fang Weijia	First Affiliated Hospital of Zhejiang University School of Medicine	Hangzhou	9
Chen Zhendong	The Second Affiliated Hospital of Anhui Medical University	Hefei	8
Pan Hongming	Run Run Run Run Shaw Hospital, Zhejiang University School of Medicine	Hangzhou	8
Wu Lin	Hunan Cancer Hospital	Changsha	8
Zhao Jun	Peking University Cancer Hospital	Beijing	8
Dong Xiaorong	Union Hospital of Tongji Medical College, Huazhong University of Science and Technology	Wuhan	7
Hu Jianda	Union Hospital of Fujian Medical University	Fuzhou	7
Jiang Zefei	The Fifth Medical Center of the Chinese People's Liberation Army General Hospital (formerly 307 Hospital)	Beijing	7
Shen Lin	Peking University Cancer Hospital	Beijing	7
Zhang Qingyuan	The Affiliated Tumor Hospital of Harbin Medical University	Harbin	7

2019 PI ranking of domestic tumor trials (in terms of number)

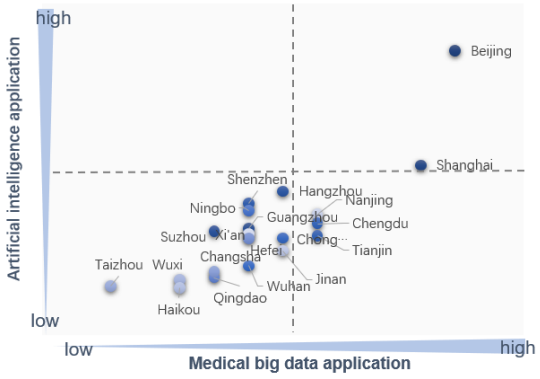
Key PI	Hospital Name	City	Local clinical #
Cheng Ying	Jilin Provincial Tumor Hospital	Changchun	41
Shi Yuankai	Chinese Academy of Medical Sciences Cancer Hospital	Beijing	33
Cui Jiuwei	The First Hospital of Jilin University	Changchun	30
Li Jin	Shanghai Oriental Hospital	Shanghai	28
Pan Yueyin	The First Affiliated Hospital of University of Science and Technology of China	Hefei	27
Zhang Qingyuan	The Affiliated Tumor Hospital of Harbin Medical University	Harbin	24
Chen Zhendong	The Second Affiliated Hospital of Anhui Medical University	Hefei	23
Fang Jian	Peking University Cancer Hospital	Beijing	21
Pan Hongming	Run Run Run Run Shaw Hospital, Zhejiang University School of Medicine	Hangzhou	19
Gu Kangsheng	The First Affiliated Hospital of Anhui Medical University	Hefei	19
Liu Yunpeng	The Affiliated Hospital of China Medical University	Shenyang	19
Hu Xichun	Fudan University Cancer Hospital	Shanghai	18
Shi Jianhua	Linyi Cancer Hospital	Linyi	17
Yu Guohua	Weifang People's Hospital	Weifang	17
Zhang Yang	The Second Affiliated Hospital of Dalian Medical University	Dalian	17
Zhou Jianying	The Affiliated Hospital of Zhejiang University School of Medicine	Hangzhou	16
Lu Shun	Shanghai Chest Hospital	Shanghai	16
tension	Sun Yat-sen University Cancer Center	Guangzhou	16
Zhuang Wu	Fujian Cancer Hospital	Fuzhou	16
Cheng Ying	Jilin Provincial Tumor Hospital	Changchun	16
Shi Yuankai	Chinese Academy of Medical Sciences Cancer Hospital	Beijing	16

Source: Pharmaceutical Research Institute, only included in 2019 tumor-related clinical trials, desk studies

F. As new research and development resources for medical big data and artificial intelligence, Beijing and Shanghai are far ahead in terms of application, while other cities need further development.

P32 Big data and artificial intelligence applications and development restrictions in top cities

Medical Bid Data vs AI



Development constraints and problems

1. **Data standards**
   - The current explosive growth of medical big data, coupled with the massive increase in semi-structured and unstructured data, has brought a certain degree of difficulty to standardization and standardized management to a large extent
2. **Data technology**
   - There are a lot of huge data collection, transmission, storage, analysis, etc., and the problem of data volume interdisciplinary, which needs to be further overcome and solved.
3. **Data connection**
   - At present, the phenomenon of inconsistent horizontal and vertical management makes the management of medical big data chaotic and lacks overall planning. Medical institutions have formed a situation of independent and independent management in the use of big data. Data islands are more common.
4. **Data application**
   - Most of the more mature and practical ones are for pharmaceutical companies and insurance companies, and it is usually difficult for doctors and patients to do business (doctors are for individual patients, not based on statistical significance); real users of data models such as doctors and government officials, etc. There are huge obstacles.

The combination of big data artificial intelligence and the traditional biomedical industry will have a transformative impact on industrial innovation and development. The current medical big data + artificial intelligence as the future direction of the development of the biomedical industry is generally not highly applied in various cities, and the layout is ahead of schedule. Have a first-mover advantage for the city's future industrial development

G. At present, the national layout of health big data centers at all levels and the rapid development of urban ARTIFICIAL intelligence make it possible for big data and artificial intelligence to promote biomedical research and development in the future.

P33 National health and medical big data distribution and artificial intelligence city development index

1+7+X health care big data center level

- National data center
- Regional data center
- Application development center
- No

AI city Development Index

- ≥90分
- 40~89分
- 20~39分
- 1~19分

Province	City	5G Coverage	China 1+7+X Health and Medical Big Data Center Level [1]	Medical big data companies# [2]	Big data pilot demonstration project#[3]	China Artificial Intelligence City Development Index[4]	AI medical companies#[2]	AI-related industry scale goals (100 million yuan)
Beijing	Beijing	√	●	61	36	96.3	41	5000
Shanghai	Shanghai	√	●	47	10	49.9	17	/
Jiangsu	Nanjing	√	●	5	9	30.0	3	1000
Guangdong	Guangzhou	√	●	9	8	24.1	0	3000
Tianjin	Tianjin	√	●	2	9	21.3	0	1300
Chongqing	Chongqing	√	●	2	3	20.3	0	/
Fujian	Xiamen	√	●	1	5	9.5	0	1000
Fujian	Fuzhou	√	●	0	2	4.4	0	1000
Guizhou	Guiyang	√	●	0	3	3.7	0	/
Sichuan	Chengdu	√	●	14	2	26.4	2	3000
Shaanxi	Xi'an	√	●	2	3	22.0	1	/
Anhui	Hefei	√	●	1	2	20.1	1	1000
Shandong	Jinan	√	●	7	3	15.2	0	/
Liaoning	Shenyang	√	●	2	2	8.6	0	400
Zhejiang	Hangzhou	√	●	29	7	39.3	6	5000
Guangdong	Shenzhen	√	●	19	3	34.3	7	3000

Sources: 1. China 1+7+X Health and Medical Big Data Center, 2. IT Orange "Medical Big Data" and "Medical AI" Field Statistics, 3. Publicity of the list of pilot demonstration projects for the development of big data industry by the Ministry of Industry and Information Technology of China in 2020, 4. 36 Krypton Research Institute released the score of "The Development of Artificial Intelligence in China's 36 Cities"

4.3.3.4 Comparative analysis of urban innovation systems

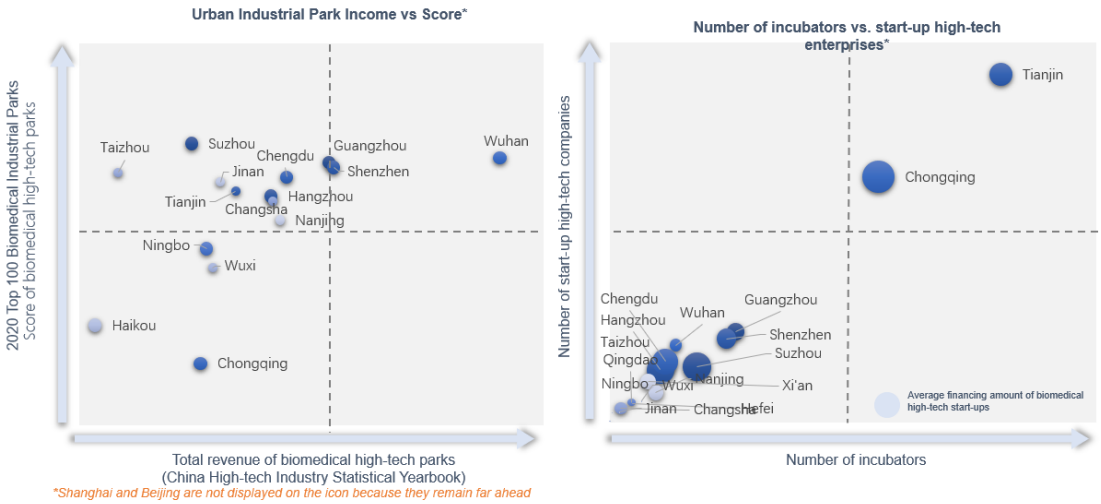
The first-level indicator city innovation system mainly includes three categories: park development, incubator construction, industrial agglomeration and maturity, to measure the development maturity of urban biomedical parks, incubator construction, and industrial agglomeration.

Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
Park development	Score of biomedical high-tech parks	Ranking (100)	+	Measure regional doctors' biomedical innovation capabilities
Park development	Total revenue of biomedical high-tech parks	Thousand	+	Measure the influence of regional doctors' biomedical innovation
Park development	Biomedicine-related investment system and management maturity (+)	Total score: 1	+	Measure the comprehensive development of the regional biomedical industry
Park development	Maturity of supporting construction (for example: training, public platform) (+)	Total score: 1	+	Measure the comprehensive maturity of the regional biomedical industry
Incubator construction	Number of biomedical incubators	#	+	Measure regional biomedical innovation capabilities and R&D potential
Incubator construction	Number of high-tech start-ups in biomedical incubators	#	+	Measure regional biomedical innovation capabilities and R&D potential
Incubator construction	Average financing amount of biomedical high-tech start-ups	Billion	+	Measure regional biomedical R&D and commercialization potential
Industrial agglomeration and maturity	Number of biomedical unicorn companies in the region	#	+	Measure the development and innovation of the regional biomedical industry
Industrial agglomeration and maturity	Clustering of upstream and downstream companies in the biological industry in the region	#	+	Measure the concentration and maturity of regional biomedical industry development
Industrial agglomeration and maturity	Cooperation degree of upstream and downstream companies in the biological industry in the region	#	+	Measure the concentration and maturity of regional biomedical industry development
Industrial agglomeration and maturity	Number of meetings in the biomedical industry (+)	Total score: 1	+	Measure the foreign exchange capacity of the regional bio-industry

Through the detailed analysis of 72 urban innovation systems, we find the following characteristics.

A. From the perspective of the development of urban industrial parks and incubators, the differences in development levels between cities have increased. The income of industrial parks reflects the current situation of industrial development, and incubators reflect the future progress of industrial innovation and development to a certain extent.

P34 The development of industrial parks and incubators in top cities



B. The construction of industrial parks in various cities is continuously accelerating, continuously promoting the innovation of the industry. Also, they cultivate a group of unicorn companies and promote their successful listing.

C. Most cities in China need to be improved in terms of the investment ability of industrial parks, and the improvement of quality is a further step in the improvement of quantity. The ways to improve investment ability involve four aspects.

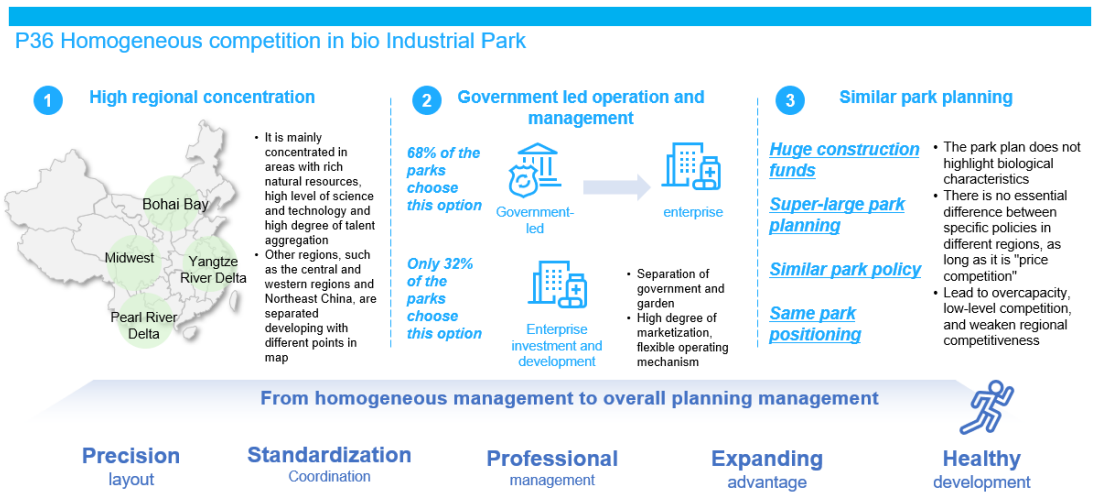
- Focus on major industrial achievement projects. Major industrialization projects can drive and lead the regional biomedical industry, and the recognized investment of major industrialization projects is generally more than 100 million yuan. For example, the Lingang New Area of Shanghai Free Trade Zone, Suzhou and Chengdu all set the investment amount of 100 million yuan as the shortlisting standard, and Beijing Daxing's 500 million yuan. The support methods and the amount of support for major projects vary from place to place. For example, Chengdu provides a maximum of 5 million yuan for 3% of fixed asset investment within two years.
- Leading companies drive industry gathering. The attraction and landing of leading companies can drive the development of the biomedical industry in the region, establish a role model and take the lead, contribute corresponding output value, tax revenue, employment opportunities, effectively attract upstream and downstream companies in the industry gather, and build a strong regional brand effect.
- Optimize the investment environment, including land subsidy, enterprise scale reward, enterprise scale reward, etc.
- With the help of external investment promotion channels. The government or a certain project unit promotes investment projects to domestic and foreign investment markets through investment intermediaries, and carries out investment promotion activities. Intermediary investment promotion has the advantages of resource information, professional services, influence decision-making and market operation. Giving full play to the advantages of intermediary investment promotion has become a common demand in the current investment promotion policies of the bio-pharmaceutical industry in various

regions, and many localities formulate intermediary investment promotion policies according to local conditions.

- Invest throughout the entire life cycle of industrial development. The public service platform is the "soft infrastructure" for the agglomeration development of the biomedical industry, and also a key node in the construction of the industrial ecology. The public service platform project involves the full life cycle of drugs such as preclinical pharmaceutical research, clinical research, application and registration, production process development, and drug sales promotion.

C. In the process of urban research, we also found that the current homogeneity competition in urban industrial parks is serious, the industrial clusters are not perfect, and overall planning is required. In the Bohai Sea Rim, the Yangtze River Delta, the Greater Bay Area, and Sichuan and Chongqing, industrial clusters and planning within the region have emerged, which has avoided regional homogeneity competition to a certain extent.

P36 Homogeneous competition in bio Industrial Park



- Bohai Rim Area——As of April 19, Beijing Cangzhou Bohai New District Biomedical Industrial Park, as a carrier for the overall undertaking of some of the pharmaceutical industry in Beijing, has gathered 12 listed companies, 61 high-tech enterprises, and 6 foreign-funded enterprises. It is located in the Beijing-Tianjin-Hebei Bio-medicine industrialization demonstration zone of Tianjin Economic and Technological Development Zone, and is expected to drive the formation of an industrial scale of 50 billion yuan in about 5 years.
- The Yangtze River Delta region——In the Yangtze River Delta, two provinces and one city cooperate in supervision to build a biomedical industrial cluster of the whole industrial chain and jointly build a public platform for the life and health industry. The Qidong Biotechnology Innovation Collaboration Park in the Shanghai Free Trade Zone builds the Yangtze River Delta biomedical industry "animal testing base", and the Zhangjiang Bio-medicine and Qidong Base becomes the Shanghai-Su Biomedical Cooperation Demonstration Zone.
- Guangdong-Hong Kong-Macao Greater Bay Area——It adopts an innovative cooperation model combining "government + enterprise + learning + research + clinical + capital" to gather upstream and downstream enterprises, scientific research institutes, universities, industry organizations, medical institutions, investment financing institutions and other industries and innovation resources. Through government support and socialized operations, we will cooperate with Hong Kong and Macau to build a number of innovation platforms

and research bases to promote effective docking and efficient integration of market resources.

- Sichuan and Chongqing area——It establishes the Sichuan-Chongqing pharmaceutical industry collaborative innovation strategic alliance to solve the common key technical problems of regional industrial development and the pharmaceutical industry, and explore the content and fields of collaboration in the pharmaceutical industry. It also improves the level of collaborative technology application of alliance members, and accelerate the progress of the coordinated development of the Sichuan-Chongqing pharmaceutical industry in order to realize the resource sharing and complementary advantages. As of 2018, Sichuan-Chongqing Cooperative Medicine has settled in nearly 40 pharmaceutical and related companies.

4.3.3.5 Comparative Analysis of City Fund System

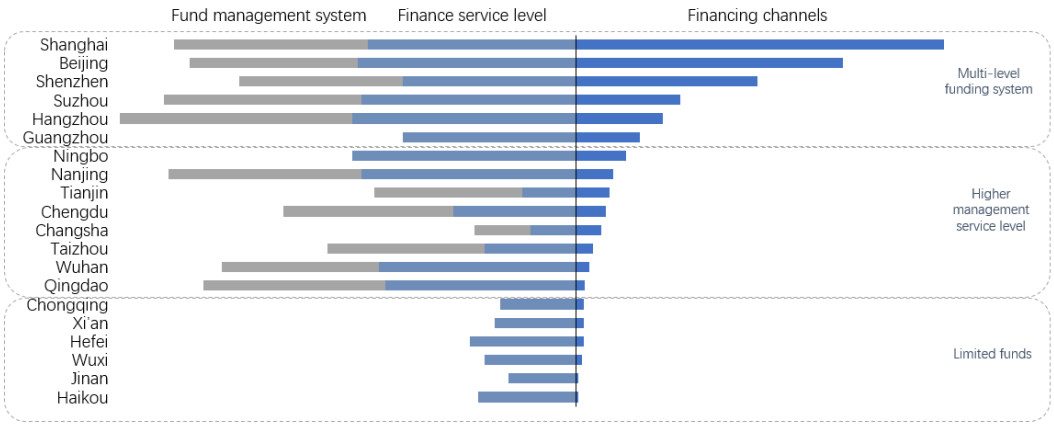
The first-level indicator city capital system mainly includes three categories: financing channels, capital management systems, and financial service levels, which are used to measure the level and quality of biomedical capital investment in cities.

Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
Financing channels	Number of biomedical enterprise funds (including early stage, entrepreneurship, and growth)	#	+	Measure the level of biomedical capital investment
Financing channels	Biomedical enterprise fund size (including early stage, entrepreneurship, and growth)	Billion	+	Measure the level of biomedical capital investment
Financing channels	Diversified financing for biomedical companies	#	+	Measure the level of biomedical capital investment
Fund management system	Biomedicine exit internal rate of return (including early stage, entrepreneurship)	%	+	Measuring the quality of biomedical capital investment
Fund management system	The proportion of biomedical investment exits from IPOs/total investment exits (including early stage, entrepreneurship)	%	+	Measuring the quality of biomedical capital investment
Financial service level	Biomedical financial services and financing costs	Total score: 5	+	Measuring the quality of biomedical capital investment
Financial service level	The maturity of the biomedical investment exit management mechanism (+)	Total score: 1	+	Measuring the quality of biomedical capital investment

Through detailed analysis of 72 cities' funding systems, we found the following characteristics.

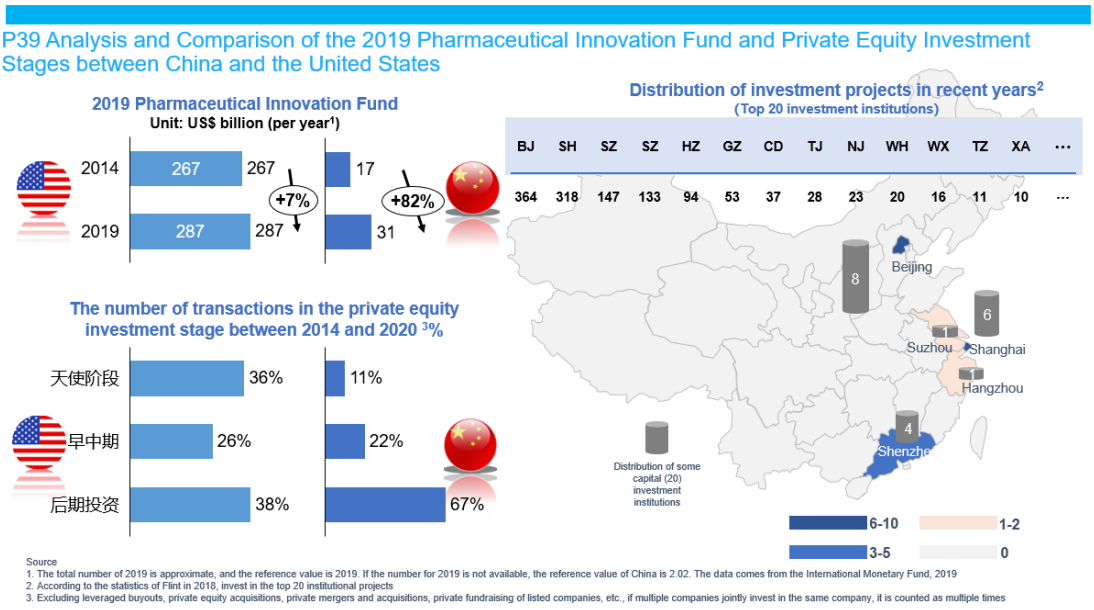
A. At present, most cities are still mainly supported by government financial funds. The financing channels have not yet formed a multi-channel and multi-level pattern. Some cities have formed a multi-level funding system. Although some cities have general financing channels, the level of fund management services is relatively low.

P37 The financing system of the top cities in the index

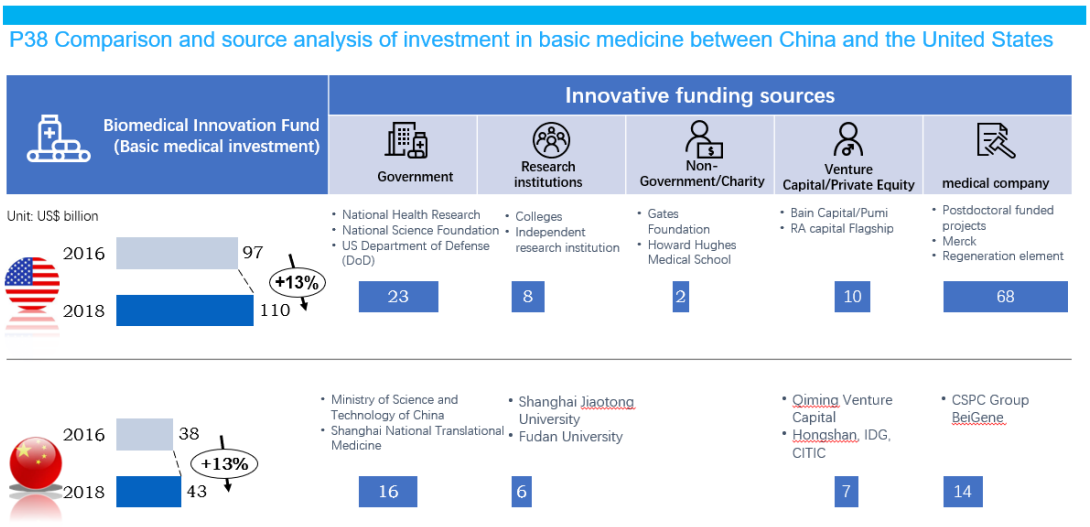


- The difficulties of establishing multi-layer financing channels in urban biomedical industry mainly come from the following aspects: Bio-medicine has obvious high risks, high professional requirements in the early stage, high investment risk, high return in the later stage and long cycle. Financial institutions in order to control the bad debt reserve ratio & the government's choice of support objects "differs from person to person". The standardization of commercial credit evaluation is not high. Information asymmetry is a serious problem in the financing of R & D.
- The establishment of urban financing channels can be improved in the following ways, such as expanding a new type of support structure with social capital as the mainstay and financial funds as a supplement, expand financing support for basic research. Also, cities could strictly establish an open and transparent credit feedback system. Banks and other credit institutions design more flexible financial products and strengthen the preliminary feasibility analysis of the project. Enterprises need to improve their internal governance structure and financial management system, and attach importance to the maintenance of corporate credit.

B. From a national perspective, there is still a big gap between the scale of financing and the diversity of channels for my country's biomedical basic medicine investment compared with the United States.

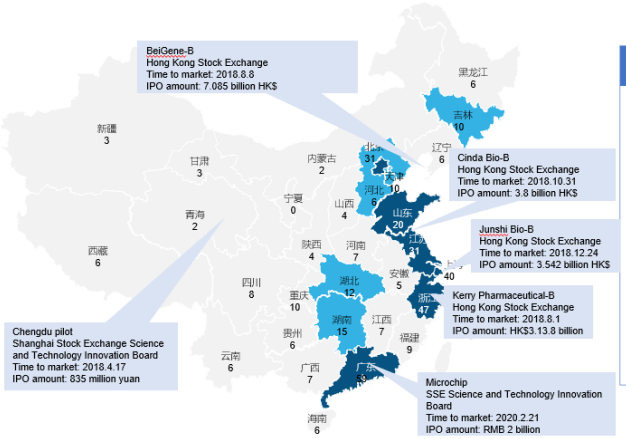


C. In 2019, the total amount of my country's pharmaceutical innovation fund increased significantly faster than that of the United States, but the overall investment in early-stage projects was not outstanding.



D. In terms of the number and amount of biomedical innovation companies successfully listed in 2019, they are also mainly concentrated in the eastern coastal cities and regions.

P40 Successfully listed biomedical companies in 2019 and their national distribu

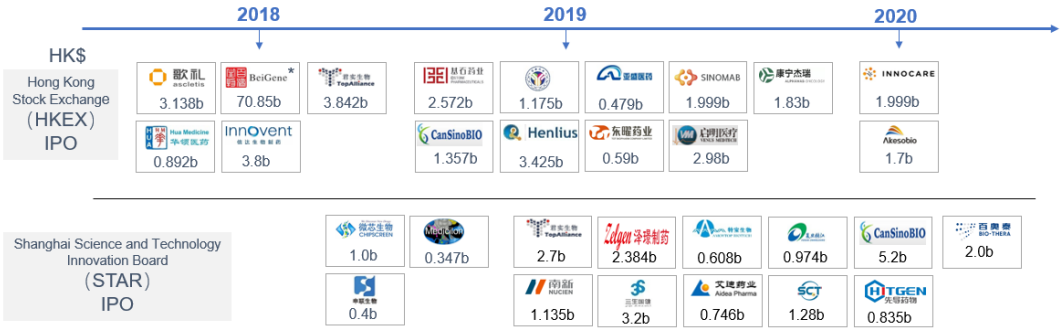


No.	Province	Successfully IPO #	%	No.	Province	IPO Amount(100 M rmb)	金额占比
1	Guangdong	59	15.21%	1	Shanghai	702.53	24.19%
2	Zhejiang	47	12.11%	2	Guangdong	375.91	12.94%
3	Shanghai	40	10.31%	3	Beijing	262.04	9.02%
4	Beijing	31	7.99%	4	Jiangsu	246	8.47%
5	Jiangsu	31	7.99%	5	Zhejiang	210.76	7.26%
6	Shandong	20	5.15%	6	Shandong	155.15	5.34%
7	Hunan	15	3.87%	7	Tianjin	124.05	4.27%
8	Hubei	12	3.09%	8	Hunan	86.79	2.99%
9	Chongqing	10	2.58%	9	Sichuan	81.66	2.81%
10	Jilin	10	2.58%	10	Liaoning	70.38	2.42%

Source: Capital IQ, Evaluate Pharma, BCG analysis, IQVIA analysis

E. The establishment of hKEX 18A enterprise and domestic science innovation board provides diversified financing channels for biomedical innovation companies.

P41 Hong Kong Stock Exchange 18A and Shanghai Branch established listed companies



- As the world's second largest biomedical technology financing center, the Hong Kong Stock Exchange has raised a total of ~16 18A companies with a total of 39.7 billion Hong Kong dollars as of April 2020, accounting for 6.7% of the total financing of the Hong Kong IPO market during the same period.
- The Shanghai Stock Exchange Science and Technology Innovation Board is a newly established board independent of the existing main board market. It is guided by technological innovation and focuses on growth companies. As of September 2, 2020, 10 innovative drug and biological products companies have been listed, accounting for 27.07% of the total.

*Source: BeiGene was listed under 18A, and then applied to the Hong Kong Stock Exchange to cancel the B suffix

4.3.3.6 Comparative analysis of urban enterprise capabilities

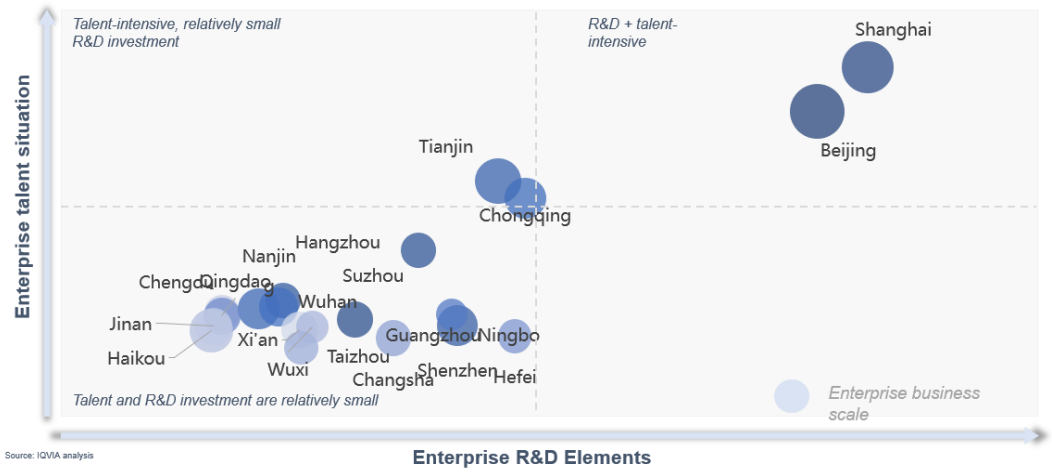
The first-level index urban capital system mainly includes three categories: enterprise business scale, enterprise talent situation, enterprise R&D factors, to measure the enterprise scale of urban biomedical industry, talent situation and enterprise R&D investment.

Level 2 Index	Level 3 Index	Unit	P/N	Index Significance
Enterprise business scale	Number of biological enterprises above designated size	#	+	Measure the development capacity of regional biomedical companies
Enterprise business scale	Total revenue from main business of biomedical companies	Billion	+	Measure the scale of the regional pharmaceutical and biological industry
Enterprise business scale	Main business growth of biomedical companies	%	+	Measure the scale and development potential of the regional pharmaceutical and biological industry
Enterprise business scale	Viability of small and micro enterprises (policy support, three-year survival rate)	Total score: 8	+	Measure regional policy support and care for small and micro enterprises
Enterprise talent situation	Employment in biomedical companies	#	+	Measure the talent reserve strength of the regional pharmaceutical and biological industry
Enterprise talent situation	Number of R&D personnel/employed persons in biomedical companies	%	+	Measure the potential of the regional pharmaceutical and biological industry R&D capabilities
Enterprise talent situation	C-level management background	#	+	Measure the innovation capability and later success of the regional pharmaceutical and biological industry
Enterprise R&D Elements	Innovative product business revenue/total business revenue of biomedical companies	yuan	+	Measure the innovation capability and later success of the regional pharmaceutical and biological industry
Enterprise R&D Elements	Biopharmaceutical company R&D investment/total business income	#	+	Measuring the R&D potential of the regional pharmaceutical and biological industry
Enterprise R&D Elements	Enterprise production capacity and technological innovation	index	+	Measure the production potential of the regional biomedical industry

Through detailed analysis of 72 cities' funding systems, we found the following characteristics.

A. Except for Beijing and Shanghai, many local governments have not realized differentiation between R&D and general production enterprises. R&D enterprises have no special treatment in terms of tax price and expense compensation, and their enthusiasm is restrained. Different from foreign enterprises, the R&D subjects of our pharmaceutical industry are mainly scientific research institutes and colleges at all levels, except some leading enterprises.

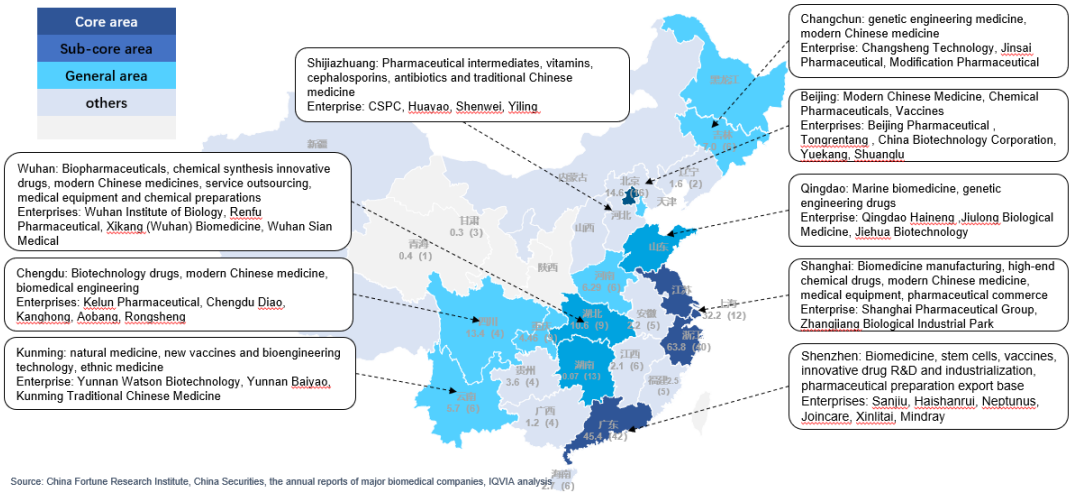
P42 Talents and R&D factors and scale of enterprises in the top cities



Source: IQVIA analysis

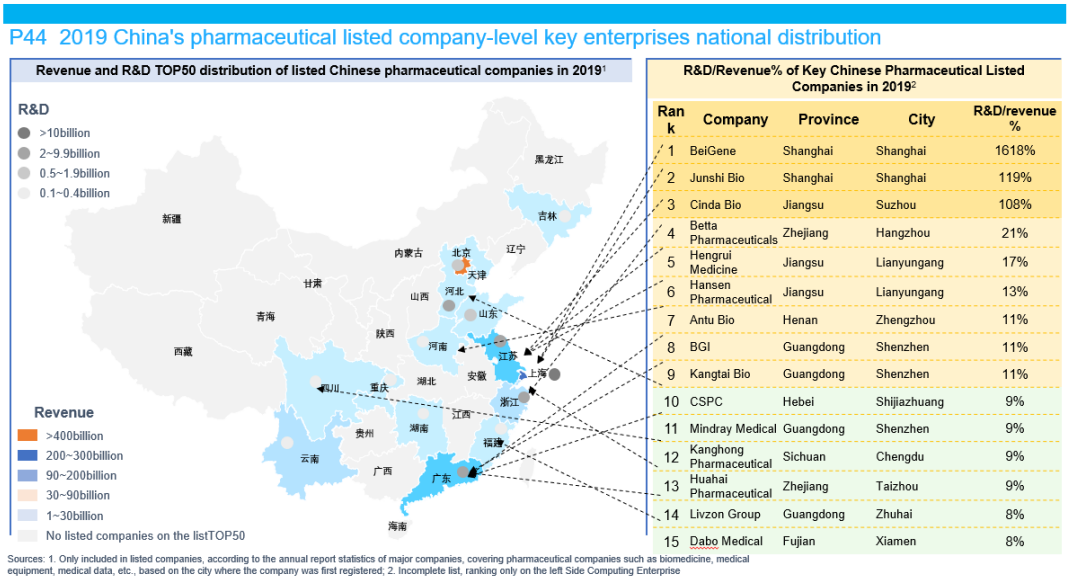
B. At present, the core cluster of urban biomedical enterprises is initially formed, covering a wide range of developed areas, and underdeveloped areas are covered by characteristic enterprises.

P43 Core development area of biomedical enterprises



Source: China Fortune Research Institute, China Securities, the annual reports of major biomedical companies, IQVIA analysis

C. Enterprises are the core engine to promote the innovation and development of cities, and the product revenue and marketization capabilities of biomedical companies will continue to drive cities forward.



E. Although the R&D investment of Chinese enterprises is increasing year by year, there is room for improvement compared with leading countries.

E. Although my country's current bio-medicine intellectual property rights conversion is insufficient, many cities have considered the rewards for the conversion of enterprise patent achievements when supporting industries, to stimulate the motivation of enterprise innovation and entrepreneurship.

P46 Transformation of biomedical achievements in China and the incentive policies of some cities

Transformation of Biomedical Achievements in China

- At present, the conversion rate of biomedical achievements in my country has been stuck at about 5%, and there is a certain gap in the demand for industrial development
- There are more than 7000 pharmaceutical companies in my country, the number is the world's first, the preparation production capacity is the world's first, and the API production capacity is the second in the world, but there is still room for improvement in the R&D and production of original drugs

Every year, the Science and Technology Bureau will have certain requirements for the number of our patents. We are also helping the Science and Technology Bureau to complete this task every year, and we can achieve them. However, the Science and Technology Bureau has not proposed such a request for us in terms of the conversion rate of biomedicine-related patents Claim

Person in charge of a city's biomedical park

Policies to encourage the transformation of biomedical achievements in some cities

City	鼓励专利转化政策
Haikou	Each item of patented technology transformed into international standards will be rewarded with 100,000 yuan, and each item of patented technology transformed into national standards and industry standards will be rewarded with 50,000 yuan and 30,000 yuan, respectively, to stimulate the motivation of independent innovation and entrepreneurship.
Xianyang	200,000 yuan of research subsidy will be given to enterprises that undertake major scientific and technological achievements of colleges and universities and successfully transform them
Xinxiang	If an enterprise or institution implements the transformation by itself or cooperates with others to implement the transformation of scientific and technological achievements, it shall allocate more than 5% of the annual net income from the implementation of the scientific and technological achievements to the relevant personnel during the profitable period after the project is successfully put into production. The completer's income is not less than 50% of the total distribution
Liuzhou	A step-by-step subsidy will be given to the purchase of scientific and technological achievements by biomedical enterprises, and the subsidy amount for a single purchase result will generally not exceed 1 million yuan. Special support will be given to "one matter, one discussion" for individual particularly significant purchase results, and the maximum subsidy amount does not exceed 2 million yuan
Ganzhou	The patent owner can extract no less than 30% of the income from the conversion of scientific and technological achievements after the patent is transferred or licensed to others. Among them, universities and research institutes can extract no less than 50% (and shall not exceed the amount of 30% of the distribution profit) as the remuneration of the inventor or designer
Tangshan	Actively promote the reform of the ownership, income rights, and distribution rights of the job-related medical science and technology achievements of universities, scientific research institutes and state-owned enterprises, and accelerate the transformation of scientific research results. During the validity period of the patent, no less than 5% of the distributable net income can be drawn as the remuneration of the inventor (designer); if the service invention is successfully converted by the person who completes it, the conversion can be enjoyed at a rate of no less than 70% Distributable net income

Source: Expert interviews, research on the transformation performance and influencing factors of scientific and technological achievements in my country's biomedical industry, IQVIA analysis

F. More and more middle-level and high-level personnel in China choose to join domestic innovative enterprises to promote the development of Chinese local enterprises, and competition for core talents in enterprises is about to start. Therefore, high-quality talents and ability training of enterprises are the basis for determining the innovation ability and competitiveness of future cities.

G. Cities should accompany enterprises to build an urban innovation system in innovation.

- Abandon traditional imitation, accumulate new drug R&D capital and experience, increase the development of innovative drugs, increase the proportion of R&D investment, and accelerate the introduction of outstanding talents to promote self-innovation of corporate biomedical companies.
- Drive the bio-industry cluster with high-tech innovative pharmaceutical companies, build all links of the innovation chain covering universities, scientific research institutions, innovation platforms, technology platforms and hospital resources, form a full biomedical cycle that can meet the functions of research and development, incubation, and commerce, and form the biomedical innovation industry cluster.
- Form an innovative city atmosphere, bring biomedical brand effect and city image through the entry of key technology companies, create an urban pharmaceutical innovation function with intensive innovation resources, complete innovation elements, complete innovation chain, strong innovation atmosphere, active innovation activities, and powerful innovation functions District, realize the system integration of the global innovation system, and promote the construction of biomedical innovation city.
- The construction of a biomedical innovation city further provides infrastructure, supporting policies, and humanistic care, further promotes enterprise innovation, builds a life and medical science innovation demonstration city, continuously improves independent innovation capabilities, and achieves industry-city integration.

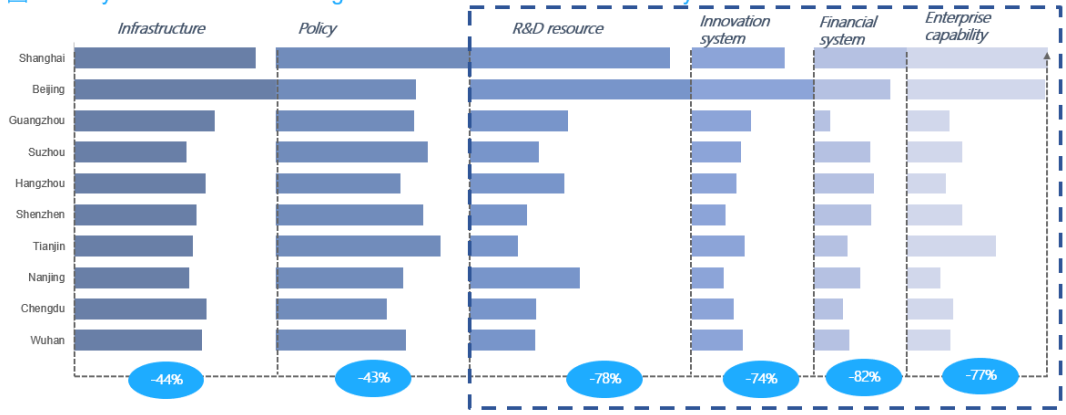
4.4 CBCII——Analysis of Key Cities

4.4.1 Current status and future potential index of key cities' industries

City	Overall Index	Industry Status Index	Future Potential Index	Overall ranking	Status ranking	Potential ranking
Shanghai	60.0	32.7	27.3	1	2	1
Beijing	59.8	33.5	26.4	2	1	2
Guangzhou	38.0	17.3	20.6	3	6	3
Suzhou	37.9	17.6	20.3	4	5	5
Hangzhou	37.0	17.9	19.1	5	4	7
Shenzhen	36.7	16.3	20.4	6	7	4
Tianjin	35.7	18.3	17.4	7	3	12
Nanjing	34.2	15.6	18.6	8	8	10
Chengdu	34.1	14.1	20.0	9	11	6
Chongqing	33.2	14.1	19.1	11	10	8
Wuhan	33.5	14.9	18.7	10	9	9
Ningbo	30.1	12.2	17.8	12	13	11
Qingdao	26.0	13.0	13.1	13	12	25
Xi'an	25.3	10.6	14.7	14	15	17
Hefei	24.5	10.5	13.9	15	16	21
Changsha	24.3	10.3	14.0	16	19	19
Taizhou	24.3	10.3	14.0	17	18	20
Wuxi	24.2	10.0	14.2	18	20	18
Haikou	23.6	7.6	15.9	19	40	13
Jinan	23.3	11.4	11.9	20	14	33

In the comparison of key cities, with infrastructure construction capabilities and policy guarantees, the core decisive points are the improvement of R&D resources and corporate capabilities, and the establishment of a relatively complete innovation system.

图47 Analysis of the difference degree of the first-level indicators of key cities

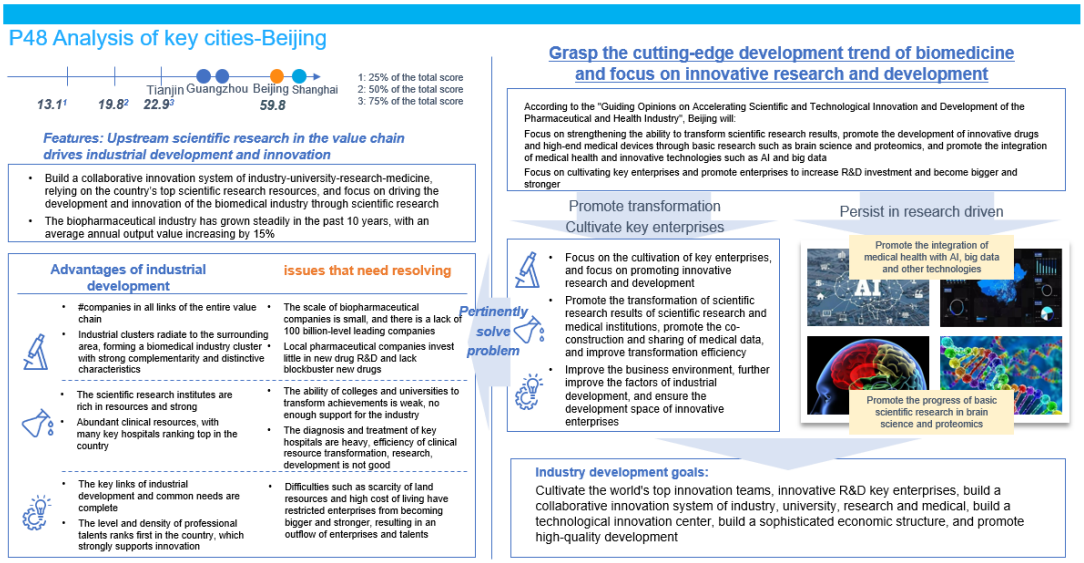


- Through the analysis of the top 20 key cities, the differences in infrastructure construction and policy guarantees among cities are relatively small, and R&D resources, innovation systems, funding systems and corporate capabilities have opened up other cities and
- The gap between Shanghai and Beijing, the advantages and experience of Shanghai and Beijing's industrial development are still worthy of further study and reference by other cities

4.4.2 Analysis of industrial characteristics of key cities

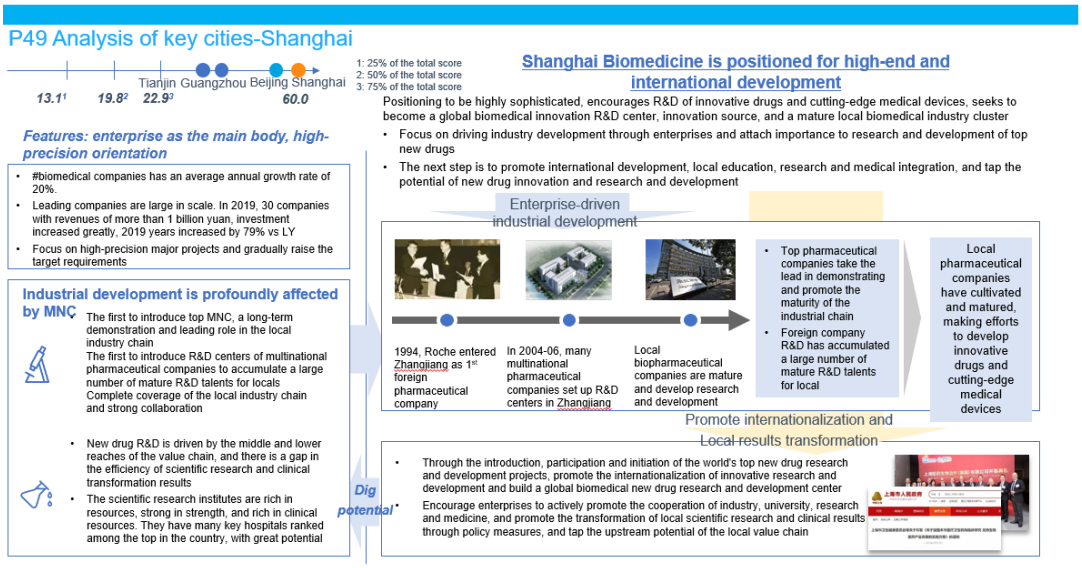
4.4.2.1 Beijing

Drive industry development through scientific research, actively improve the efficiency of scientific research results transformation, and cultivate key enterprises to achieve the development goals of the world's top innovation centers and high-tech economic structure.



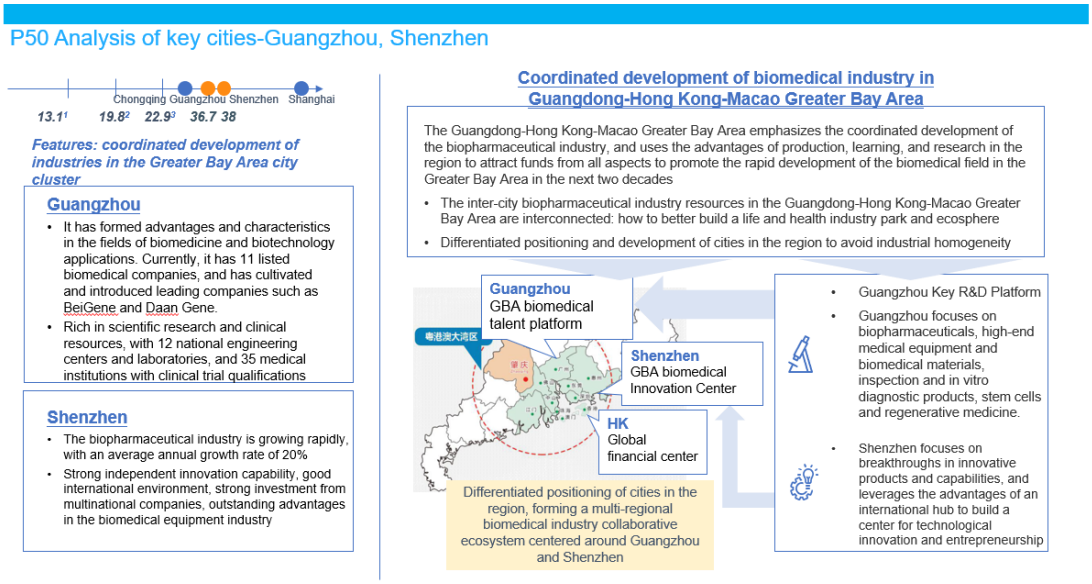
4.4.2.2 Shanghai

It focuses on driving industrial development through enterprises, the R&D of advanced biomedical products such as innovative drugs and cutting-edge medical devices, promote the internationalization of industry-university-research-medicine, and build a global biomedical new drug R&D center.



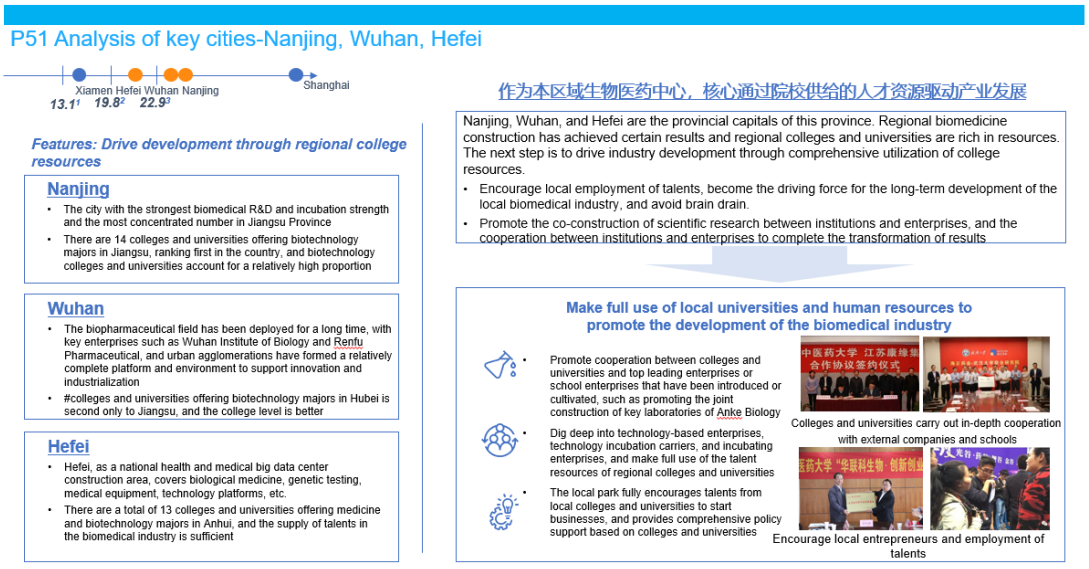
4.4.2.3 Guangzhou & Shenzhen

As an industry leader in the Guangdong-Hong Kong-Macao Greater Bay Area, it drives the development of the entire region's biomedical industry chain. Also, it will catch up with the first echelon based on a reasonable industrial layout and rapid development of regional resources.



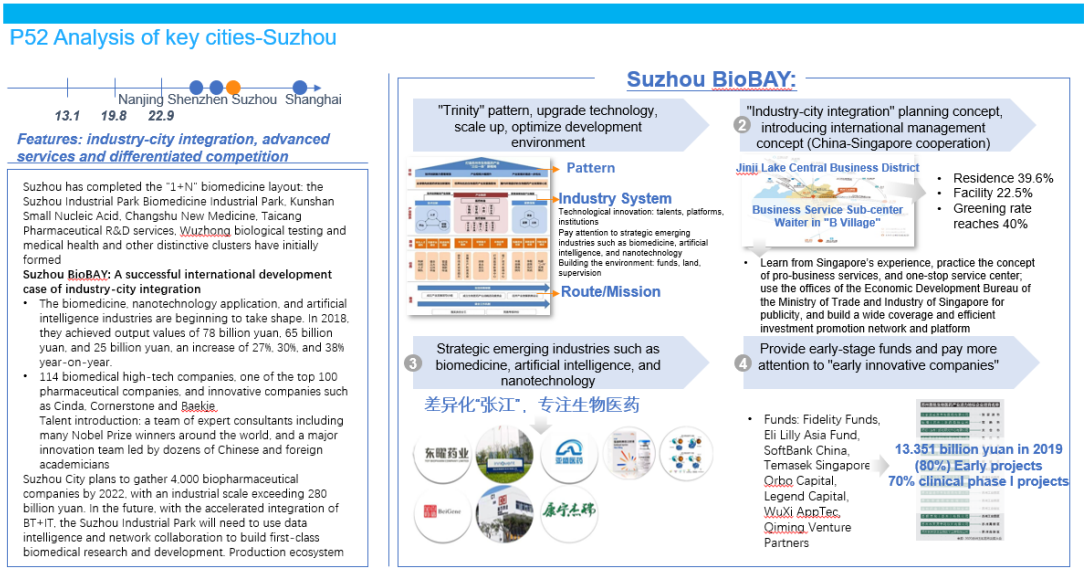
4.4.2.4 Nanjing & Wuhan & Hefei

It provides a long-term driving force for the development of Bio-medicine industry through the talent resources of colleges and universities in the region.



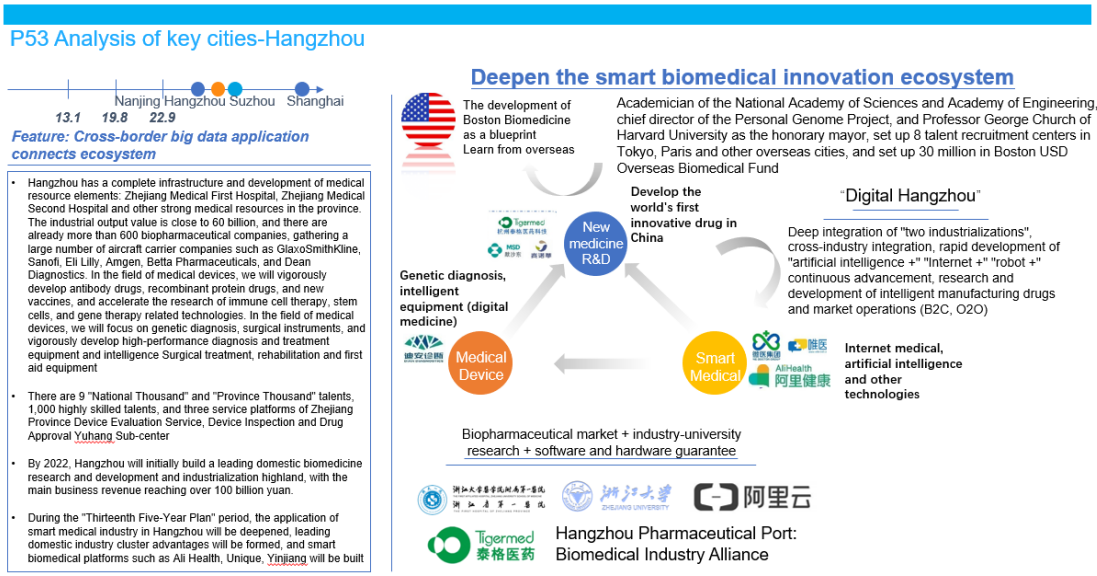
4.4.2.5 Suzhou

The top-level design is perfect. Also, it focuses on differentiated competition and aims at the development of early innovative enterprises through integration of industry and city, modern management mode and investment attraction ability.



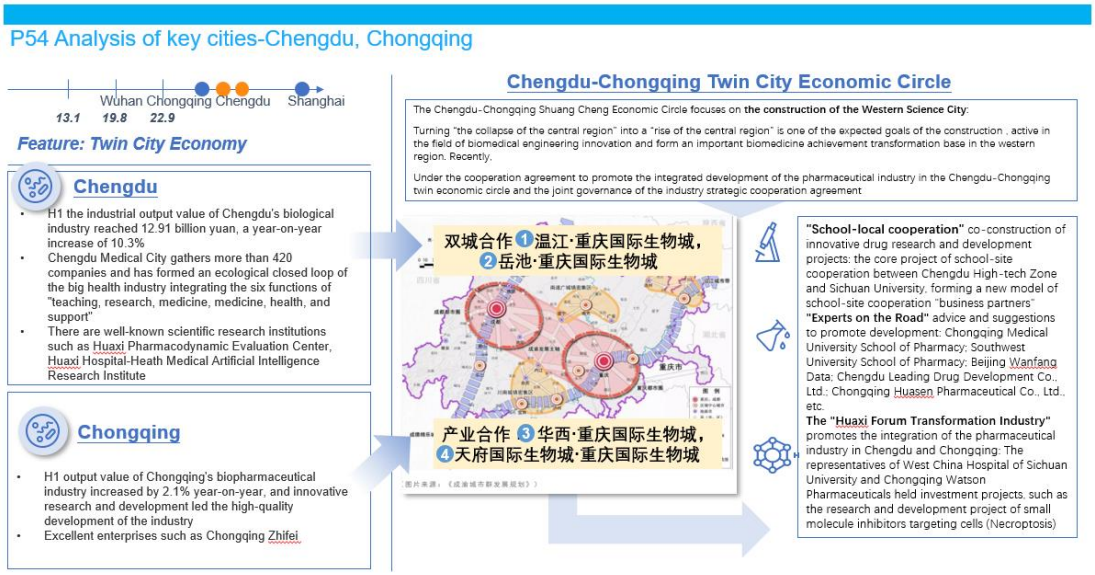
4.4.2.6 Hangzhou

The overall biomedical environment has a solid foundation, with Ali Health service as the core and big data application as the background to connect the whole industrial chain ecosystem.



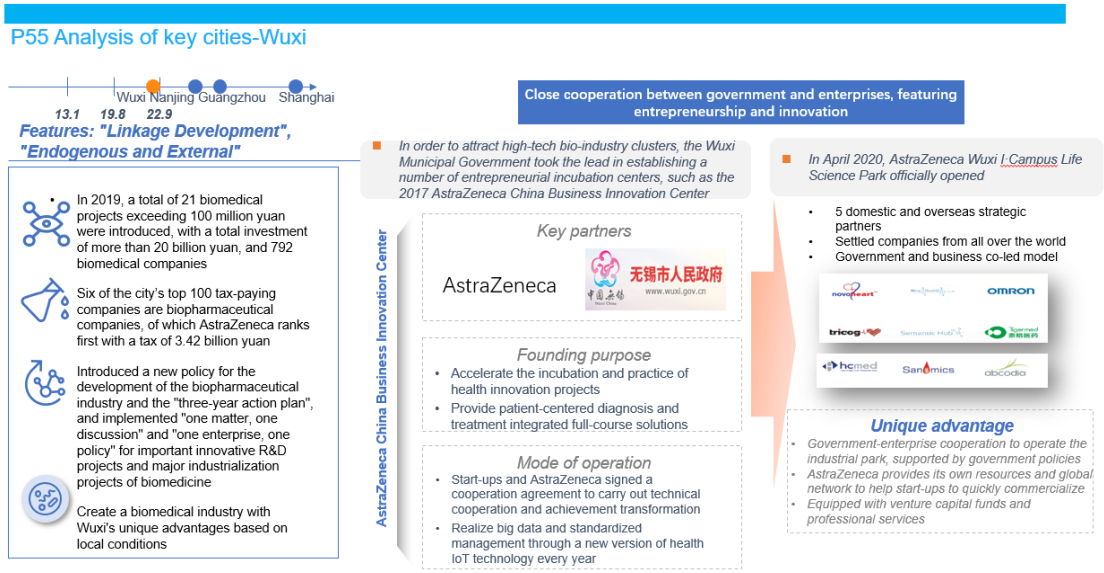
4.4.2.7 Chengdu & Chongqing

It integrates the development of intelligence, links the future biomedical innovation in Southwest China, does a good job of the "Tale of Two Cities" and builds an "economic circle".



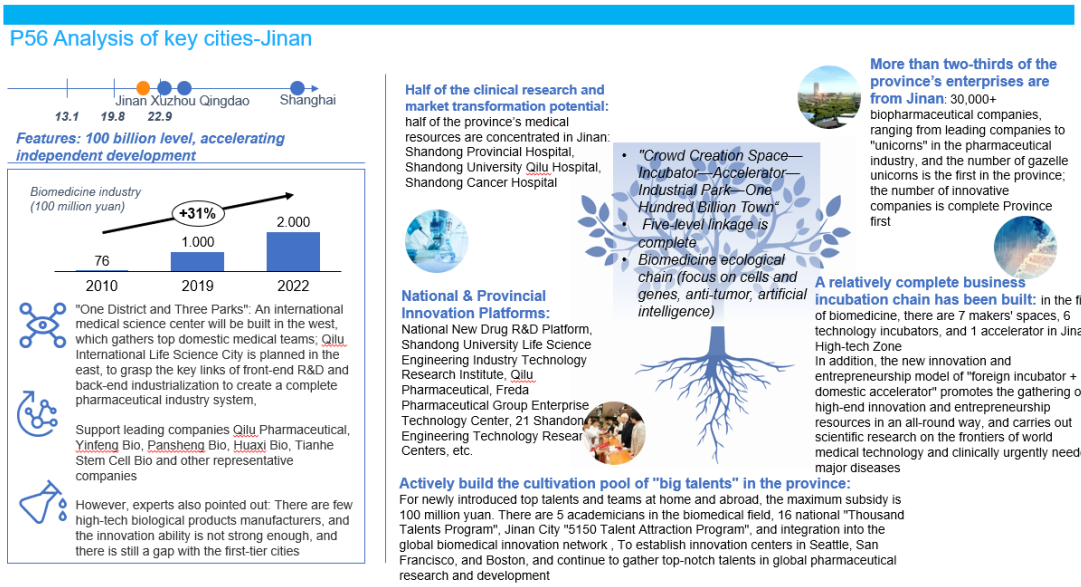
4.4.2.8 Wuxi

Wuxi actively introduces world-class biomedical industry and key projects, with entrepreneurship and innovation as the main features. Also, it encourages the incubation of bio-innovative enterprises and the transfer of results through a combination of government and enterprises.



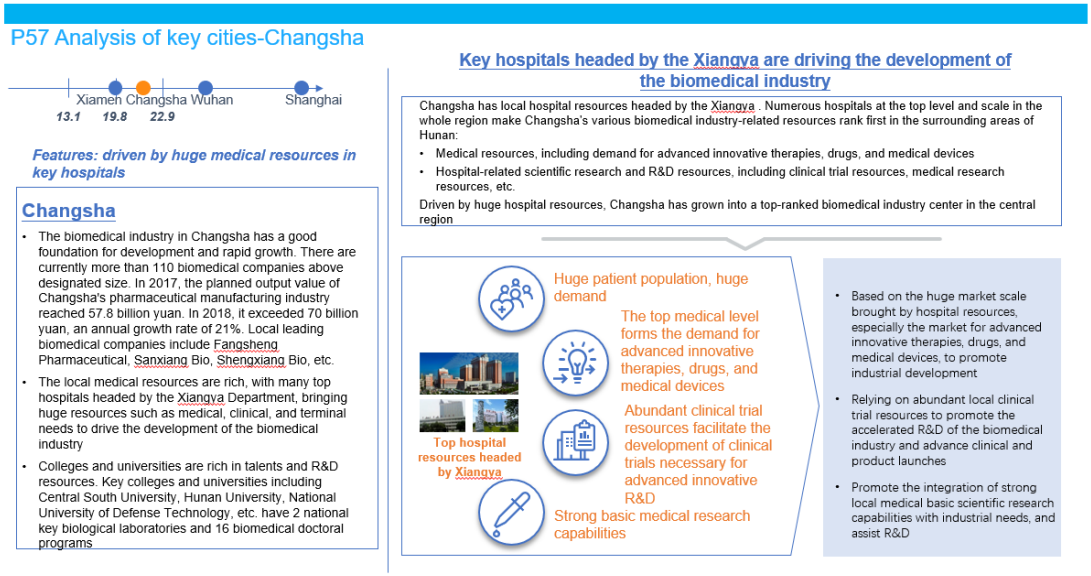
4.4.2.9 Jinan

It has received strong support from Shandong Province, brought together leading companies, core biomedical resources and national talents, and contributed to the bio-industry revenue.



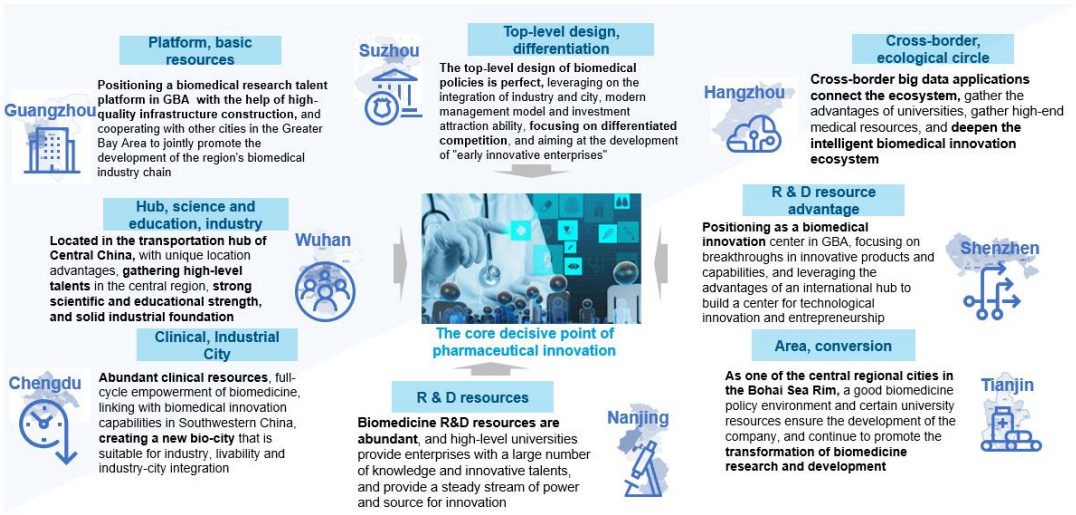
4.4.2.10 Changsha

It is driven by the key hospitals headed by the Xiangya Department, relying on the support of huge medical and clinical research resources to develop the biomedical industry.



Finally, through a multi-angle analysis of key cities, we found that the core competitiveness of a city mainly comes from the unique industrial resources of each city, each with its own advantages, forming a differentiated development.

P58 Sources of key cities' competitiveness

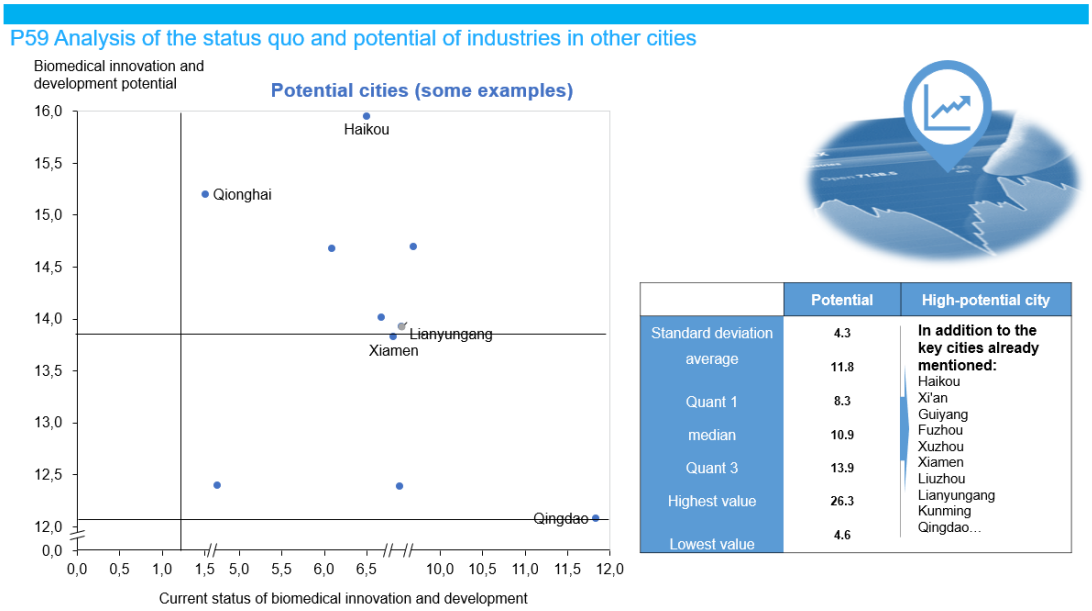


Source: Desk study, IQVIA analysis

4.4.3 Analysis of other potential cities

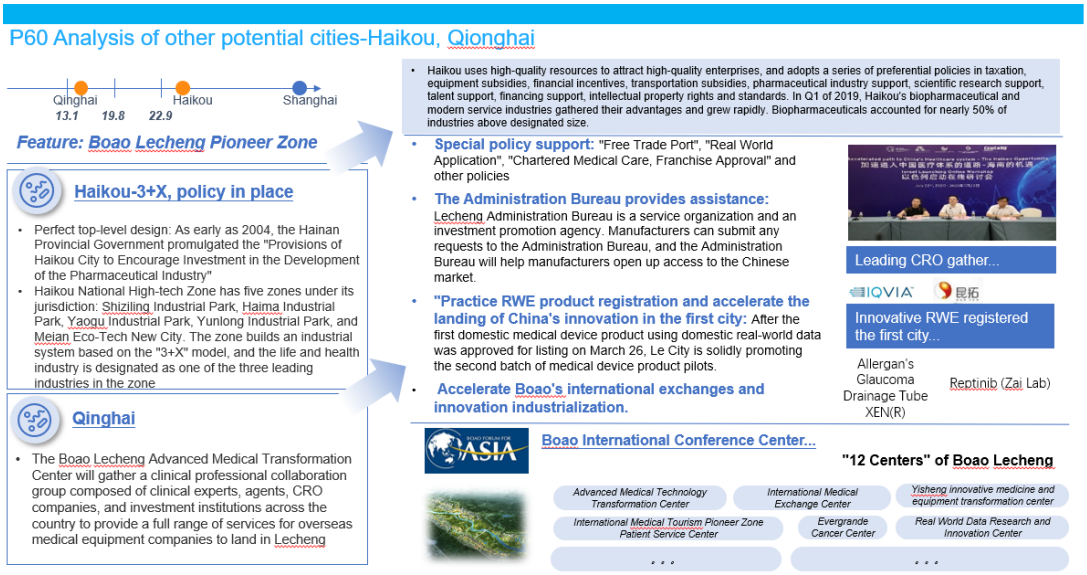
4.4.3.1 Analysis of other cities

In other urban agglomerations, we also found that some cities, such as Haikou, Qionghai, Xiamen, and Lianyungang, have obvious growth potential, and future industrial development can be expected.



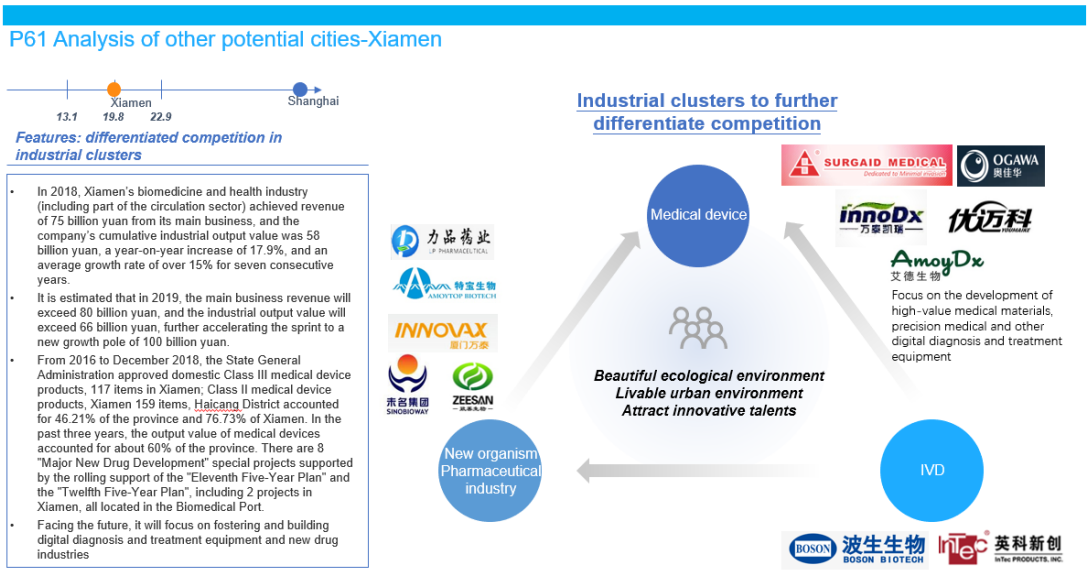
4.4.3.2 Haikou & Qinghai

Haikou and Qinghai form the capital economic circle of Qiongbei City, and Boao Lecheng gathers industry-leading companies to implement RWE product registration and accelerate the landing of China's innovation in the first city.



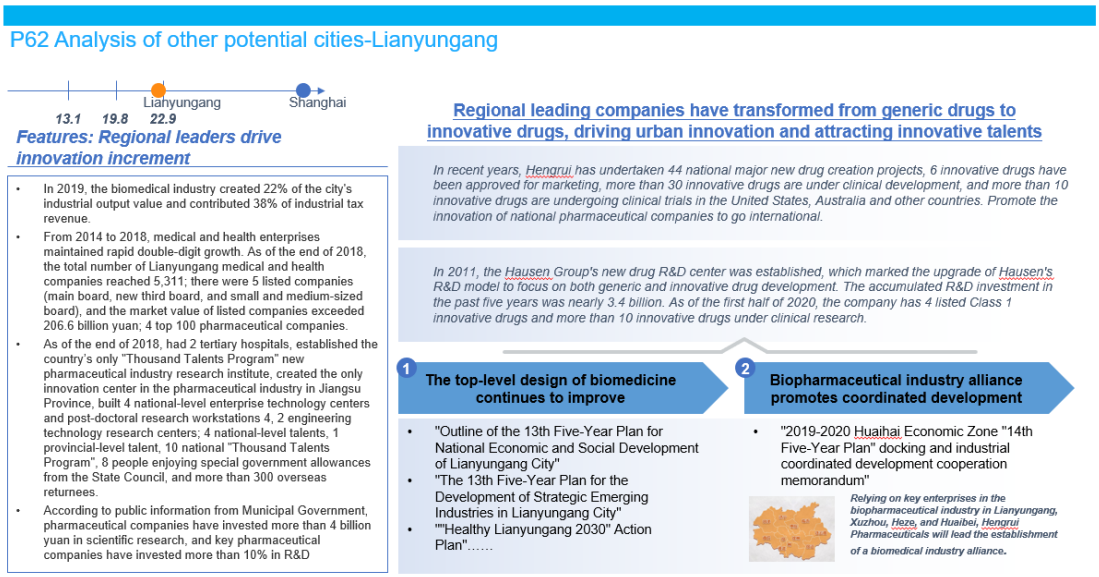
4.4.3.3 Xiamen

Xiamen has formed an industrial cluster in specialty medical equipment and in vitro diagnostics. In the future, it will further attract talents with its urban livable environment and corporate innovation capabilities.



4.4.3.4 Lianyungang

Leading enterprises in the Lianyungang region have transformed from imitation to innovation, further driving urban innovation. In the future, based on consolidating innovation and development carriers, they will explore the improvement of cross-regional organizational resource capabilities.



4.5 CBCII——Analysis of Segmented Fields

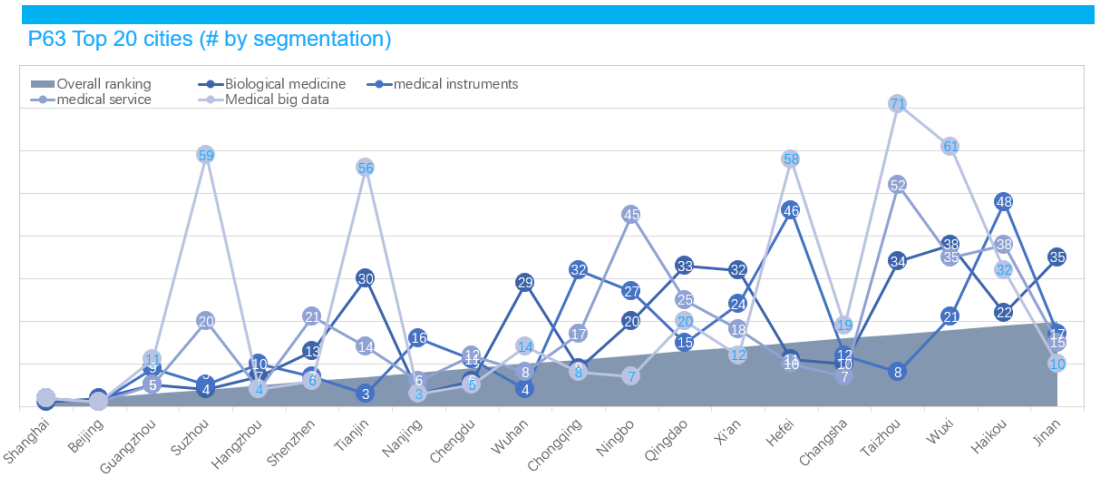
4.5.1 Ranking of city segments

Overall ranking		Segementation index				Segmentation ranking			
		Biological medicine	Medical device	Medical service	Medical big data	Biological medicine	Medical device	Medical service	Medical big data
Shanghai	1	32.0	4.0	6.6	16.9	1	2	2	2
Beijing	2	22.5	5.3	9.7	21.0	2	1	1	1
Guangzhou	3	14.0	1.6	3.2	11.5	5	9	5	11
Suzhou	4	15.2	2.9	0.6	3.8	4	5	20	59
Hangzhou	5	11.9	1.5	3.9	13.4	7	10	4	4
Shenzhen	6	8.6	2.4	0.6	12.3	13	7	21	6
Tianjin	7	3.8	3.2	1.2	5.7	30	3	14	56
Nanjing	8	15.5	0.9	3.0	13.4	3	16	6	3
Chengdu	9	12.1	1.4	1.4	13.1	6	11	12	5
Wuhan	10	5.2	2.9	2.2	10.5	29	4	8	14
Chongqing	11	10.8	0.1	1.1	12.0	9	32	17	8
Ningbo	12	7.0	0.2	0.1	12.1	20	27	45	7
Qingdao	13	2.3	0.9	0.4	9.4	33	15	25	20
Xi'an	14	2.9	0.3	1.0	11.4	32	24	18	12
Hefei	15	9.7	0.1	2.1	4.3	11	46	10	58
Changsha	16	10.6	1.4	2.4	9.6	10	12	7	19
Taizhou	17	2.3	2.2	0.1	0.1	34	8	52	71
Wuxi	18	0.7	0.3	0.2	1.6	38	21	35	61
Haikou	19	7.0	0.0	0.1	8.4	22	48	38	32
Jinan	20	1.9	0.7	1.2	11.6	35	17	15	10
Xuzhou	21	0.1	0.1	0.3	8.6	47	32	27	28
Guiyang	22	7.0	0.0	0.2	10.1	21	55	34	16
Fuzhou	23	7.2	0.1	1.1	10.1	16	32	16	15
Lianyungang	24	9.5	0.0	0.0	7.0	12	55	61	46
Xiamen	25	11.0	0.9	0.3	11.9	8	13	29	9
Kunming	26	7.1	0.0	0.4	9.3	19	55	26	21
Shijiazhuang	27	0.3	0.0	0.6	7.8	44	48	19	34
Zhuhai	28	7.2	0.9	0.0	8.0	17	14	57	33
Harbin	29	0.8	0.0	2.1	10.0	37	55	9	17
Changchun	30	0.6	0.2	4.2	9.1	39	25	3	24
Foshan	31	7.0	0.1	0.1	1.6	22	32	53	62
Nanchang	32	1.8	0.2	0.6	10.0	36	29	22	18
Changzhou	33	7.0	2.5	0.1	10.5	22	6	44	13
Huzhou	34	0.0	0.1	0.1	1.6	54	32	51	63
Liuzhou	35	0.0	0.0	0.1	0.8	54	55	43	67
Nantong	36	0.3	0.1	0.1	7.7	42	30	40	37
Shenyang	37	3.1	0.1	1.3	4.8	31	32	13	57

Jiaxing	38	7.0	0.1	0.0	8.5	22	32	64	30
Nanning	39	7.2	0.4	0.5	7.8	18	20	23	36
Jinhua	40	0.0	0.1	0.0	7.1	54	42	66	42
Lanzhou	41	0.3	0.1	0.3	8.6	43	30	32	27
Yantai	42	0.0	0.1	0.1	8.5	53	42	48	29
Wenzhou	43	0.3	0.1	0.3	7.0	41	42	30	43
Dalian	44	7.4	0.1	0.4	8.9	14	32	24	25
Taizhou	45	0.0	0.1	0.1	7.0	54	32	55	45
Zhengzhou	46	0.6	0.5	1.6	8.6	40	18	11	26
Shaoxing	47	0.0	0.0	0.0	0.2	54	48	58	70
Xinxiang	48	0.1	0.3	0.1	8.4	49	23	49	31
Dongguan	49	0.0	0.0	0.1	1.0	54	55	47	65
Linyi	50	0.0	0.0	0.3	1.5	54	55	28	64
Zhongshan	51	0.0	0.1	0.0	0.9	54	46	59	66
Ganzhou	52	0.0	0.0	0.0	0.7	54	55	62	69
Weifang	53	0.0	0.2	0.3	7.8	54	27	33	35
Yangzhou	54	0.1	0.2	0.1	0.0	46	25	46	72
Zibo	55	0.0	0.5	0.2	7.2	54	19	37	40
Urumqi	56	0.0	0.0	0.3	7.7	50	55	31	38
Qionghai	57	7.0	0.0	0.0	7.0	22	55	69	43
Yancheng	58	0.0	0.1	0.0	7.7	54	42	64	39
Texas	59	7.0	0.0	0.0	7.0	22	55	69	46
Heze	60	0.0	0.1	0.0	7.0	54	32	69	49
Baoding	61	0.0	0.0	0.1	7.0	51	48	42	46
Zhenjiang	62	0.1	0.3	0.1	7.0	48	22	40	49
Yueyang	63	0.0	0.0	0.0	7.0	54	55	60	49
Tangshan	64	0.0	0.0	0.1	7.1	52	48	56	41
Langfang	65	7.0	0.0	0.0	7.0	22	48	68	49
Wuhu	66	7.2	0.0	0.1	0.7	15	55	54	68
Taiyuan	67	0.1	0.0	0.1	9.3	45	48	39	22
Liaocheng	68	0.0	0.0	0.0	7.0	54	55	66	49
Hohhot	69	0.0	0.0	0.2	2.8	54	55	36	60
Cangzhou	70	0.0	0.0	0.1	7.0	54	55	50	49
Handan	71	0.0	0.0	0.0	9.2	54	55	62	23
Xuchang	72	0.0	0.0	0.0	7.0	54	55	69	49

4.5.2 Comparative analysis of city segments

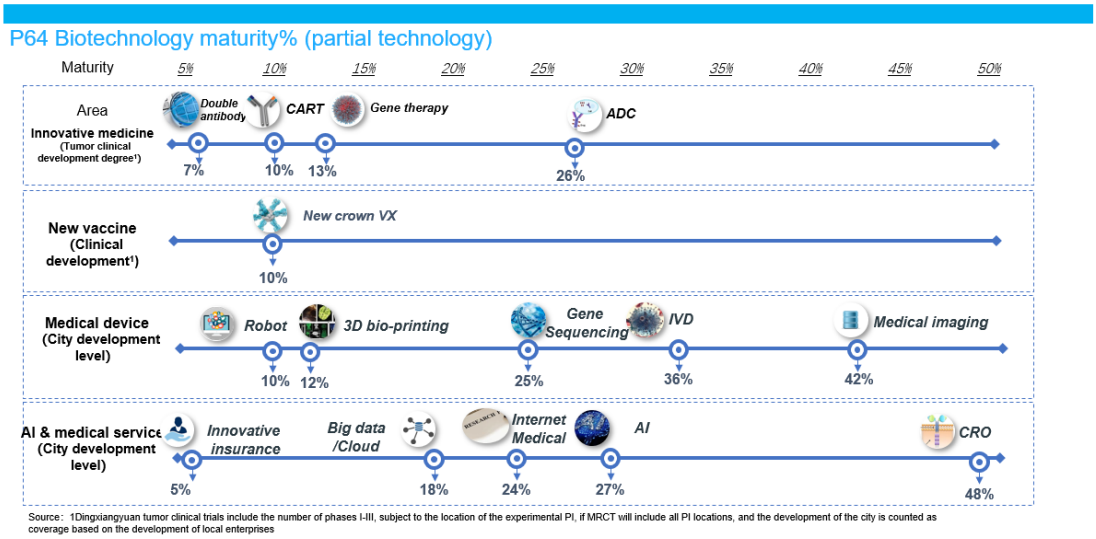
The field of city segmentation mainly covers four aspects in this research: biological medicine (including vaccines), medical devices, medical services (including CRO&CMO, etc.), and medical big data (including artificial intelligence, Internet medical services, etc.). There is a relatively large difference in the development of subdivisions in various cities across the country. Through the analysis of the top ten cities, the difference between the key cities of bio-medicine and medical services is obvious, while the development of medical equipment and big data is relatively balanced.



According to the analysis of the ranking of the top 20 cities in the subdivisions, the development of each subdivision of Shanghai, Beijing, Guangzhou, Hangzhou, Shenzhen, Nanjing, Chengdu, Changsha, Jinan is relatively balanced, and Suzhou, Tianjin, Wuhan, Chongqing, Ningbo, etc. It has obvious characteristics in the development of subdivisions.

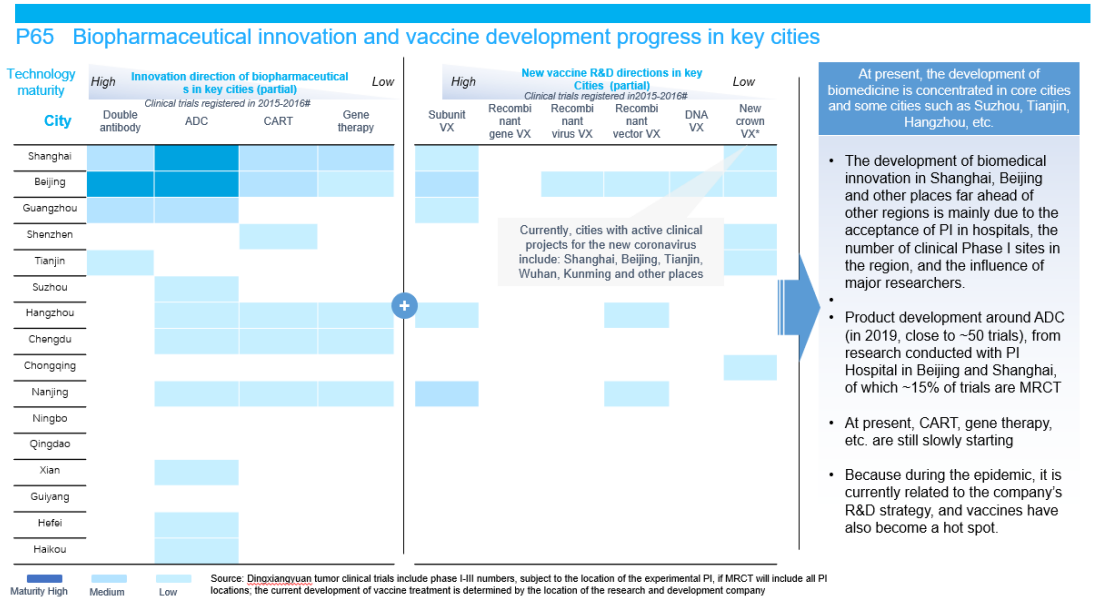
4.5.2.1 Analysis of technology maturity in segmented fields

From the perspective of the maturity of technological development, the current technical development in the field of medical devices and medical services at the national level is relatively mature, while the development of bio-medicine is limited by the small number of PI doctors in hospitals. At present, the development of medical devices and artificial intelligence relies on technological breakthroughs and infrastructure construction, and development can be carried out quickly.

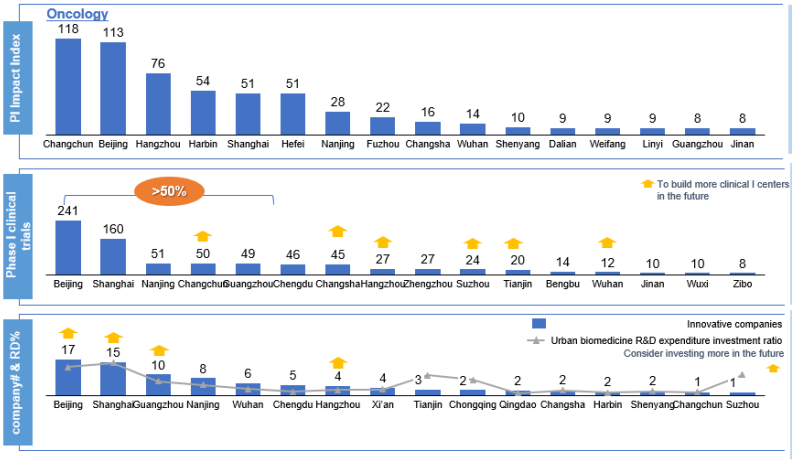


4.5.2.2 Comparative analysis of urban bio-pharmaceutical development

4.5.2.2.1 The development direction of biomedical technology is currently focusing on double antibodies, ADC, CART, and new influenza (including the new crown vaccine) as the main research directions, which have improved in key cities. Beijing is the most mature in the development of double antibodies and ADC drugs. Shanghai is making rapid progress in ADC drugs. Beijing and Shanghai have a more comprehensive layout in biological drugs and new vaccines. Other key cities are part of the layout, and Ningbo and Qingdao have not yet been deployed. Urban biomedical technology innovation is closely related to local PI hospitals, corporate innovation characteristics, and the number of clinical centers.



P66 Performance comparison of key indicators in the field of innovative biological drugs



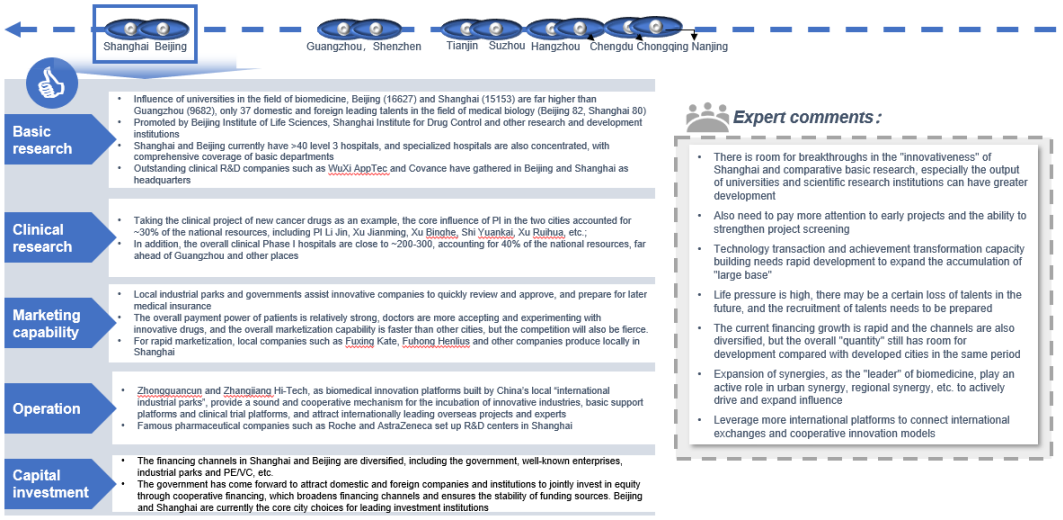
Core PI include: Cheng Ying (Jilin Cancer Hospital); Qin Shukui (The 81st Hospital of the Chinese People's Liberation Army); Zhou Jianying (The First Affiliated Hospital of Zhejiang University School of Medicine); Shi Yuankai (Tumor Hospital of the Chinese Academy of Medical Sciences); Li Jin (Shanghai) Dongfang Hospital); Cui Jiuwei (First Hospital of Jilin University); Lu Shun (Shanghai Chest Hospital), etc.

From the Phase I clinical trial registered with CDE in January 2019, the top five cities accounted for >50% of the resources. However, with the development of GCP in the future, more and more cities and hospitals will build phase I clinical centers. Improve new drug research and development capabilities

Innovative companies gather in core cities such as the Yangtze River Delta and Beijing. With the transformation of enterprises and the support of policies, the overall urban R&D investment ratio has increased compared with previous years

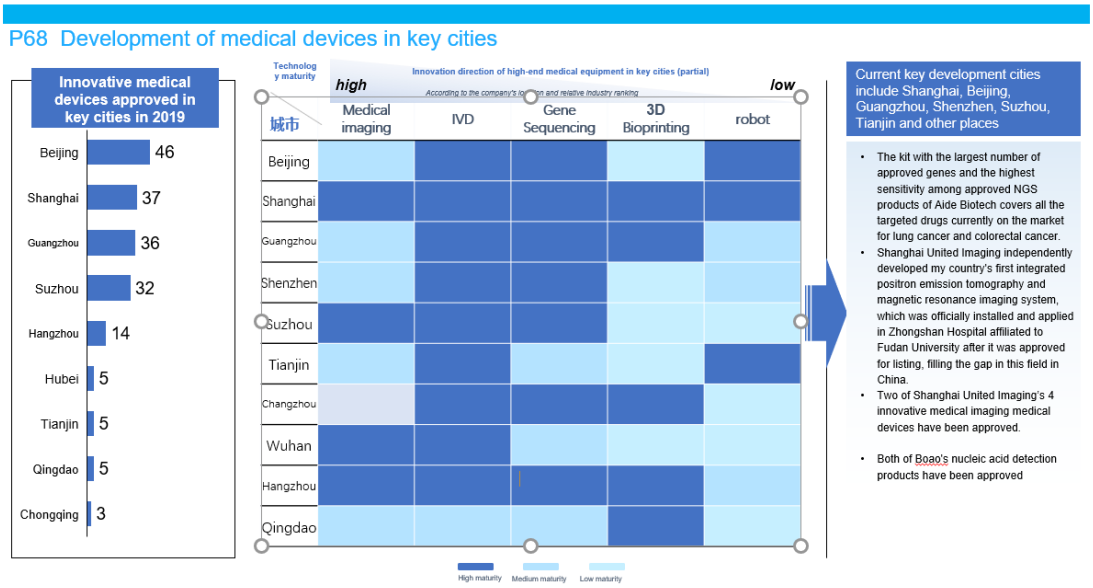
4.5.2.2.2 Summary of Beijing and Shanghai innovative bio-pharmaceutical development experience: the gathering of biomedical companies, the promotion of innovative investment, the accumulation of research institutions and early basic talents are all important development factors.

P67 Biomedicine-Beijing & Shanghai experience

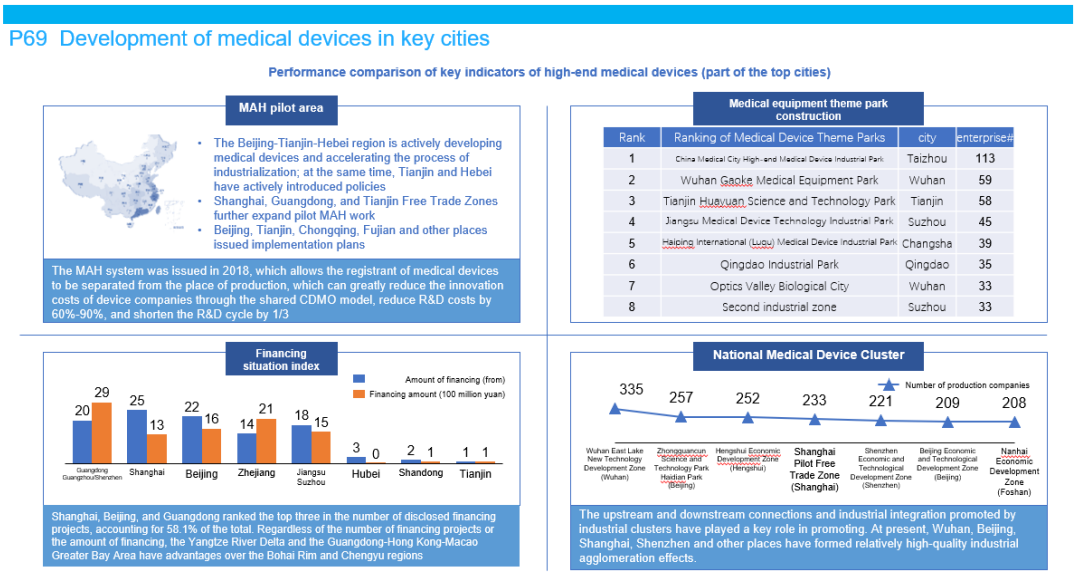


4.5.2.3 Comparative analysis of the development of urban high-end medical equipment

4.5.2.3.1 Key cities for the development of high-end medical devices include Shanghai, Beijing, Guangzhou, Shenzhen, Suzhou, Tianjin, etc., focusing on medical imaging, IVD, genetic diagnosis, etc.



4.5.2.3.2 The core development path includes the promotion of innovation policies (the opening of the device MAH policy), capital blessing, the acceleration of the approval process, and the construction of key capabilities such as industrial clustering.



4.5.2.3.3 Summary of development experience in Beijing, Shanghai, Suzhou and Shenzhen.

图70 Summary of medical device development in Shanghai, Beijing, Suzhou and Shenzhen

Development of high-end medical equipment in Shanghai Free Trade Zone	Beijing's high-end medical equipment development	Jiangsu Medical Device Technology Industrial Park	Shenzhen Medical Device Development
Leveraging on the influence of the MAH policy to quickly promote CDMO services, focusing on molecular diagnostics and other fields	The Beijing Municipal Drug Administration promotes Beijing's policy impact on accelerating innovation in medical devices	Three parties jointly build (government-industry-academic) medical device industry transformation to promote development	Leverage existing leading companies to tap high-end industry R&D capabilities and merge AI and pharmaceuticals
• CDMO services for medical device products under the medical device registrant system, including process verification, pilot conversion, commissioned production, commissioned inspection, and production system document writing are a one-stop solution, which greatly reduces the investment cost of science and technology enterprises before product sales And compliance risks. • Shanghai Free Trade No. 1 Life Science and Technology Industrial Park is located in the core area of Shanghai Free Trade Zone-"bonded" + "free trade" superimposed advantages, reasonable space allocation, and create an innovative highland for medical device bonded research and development in Shanghai Free Trade Zone. • According to different technology platforms, the park sets up supporting professional GMP production lines to meet the requirements of different products. Continue to build a complete set of reagent technologies for technology platforms such as immunoturbidimetry, POCT, chemiluminescence, and molecular diagnosis	• The Beijing Municipal Food and Drug Administration has provided guidance and standardization for the product quality system of start-up companies in advance, so that the time limit for quality system verification can be greatly shortened from the original 30 days to 6 days. The inspection cycle of large-scale medical devices with high technological content From the past nearly 3 months to 1.5 months, the inspection cycle of all innovative products is shortened by more than 1/3 on average • Innovative medical device product license approval and product quality system verification are carried out simultaneously. After the company obtains the medical device registration certificate issued by the State Drug Administration, it can obtain the production license from the Beijing Municipal Drug Administration as soon as possible. • The approval of the second-class innovative medical devices within the scope of responsibility has also been fully accelerated, a green channel has been opened, and the entire process approval time limit has been shortened from 170 days to an average of 22 days	• Suzhou High-tech Zone and the Chinese Academy of Sciences jointly established the Suzhou Institute of Biomedical Engineering Technology, which is currently the only professional medical device industry transformation demonstration in China • The Suzhou Medical Device Research Institute of Southeast University is jointly established by Suzhou High-tech Zone, Southeast University, and Jiangsu Industrial Technology Research Institute • The research institute has established a product-oriented, joint technical team and enterprise joint development, giving full play to the respective advantages of the three parties and accelerating the process of product marketization. The institute has established four research and development directions for bionic organs and organ chips, biomedical materials, medical imaging and big data, in vitro diagnostics (IVD) and detection technology.	• The medical device industry in Shenzhen is built on the basis of the electronics industry. The mechatronics industry is developed and has a high degree of aggregation • The rapid development of new digital imaging technology for clinical diagnosis, new repair material preparation technology, major chronic disease screening diagnostic equipment, digital surgical equipment, in vitro diagnostic equipment and reagents, etc. • Currently using: AI + medical equipment, medicine + medical equipment, the whole process and other innovative concepts to promote development

Shanghai's development of medical equipment mainly relays the Shanghai Free Trade Zone policy, combines the MAH system to rapidly promote CDMO services, and focuses on molecular diagnostics and other fields.

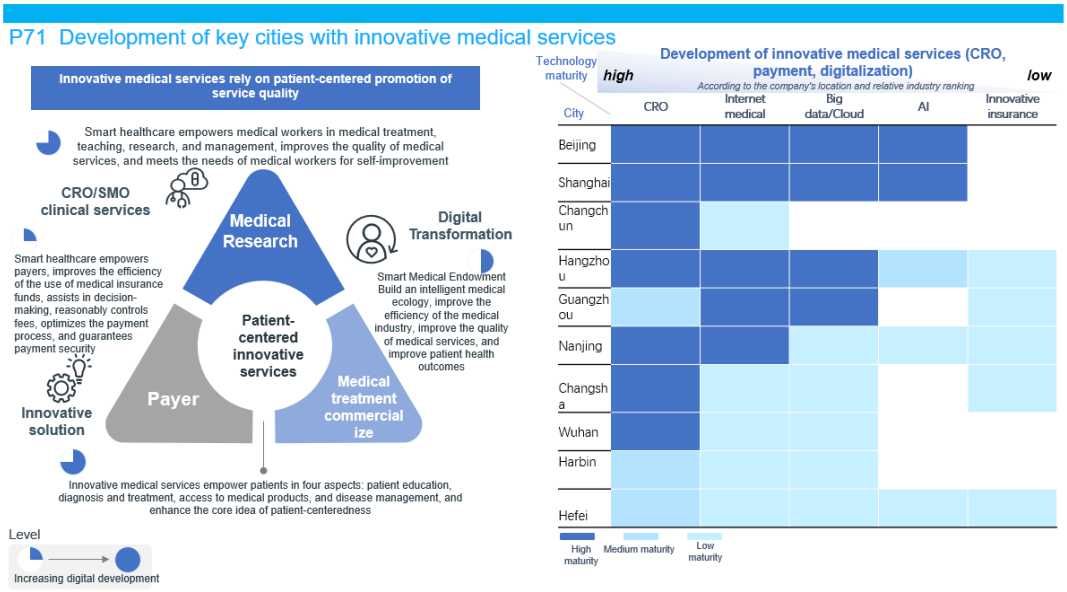
The rapid development of medical devices in Beijing benefited from the influence of the Beijing Municipal Drug Administration, especially the early guidance and specifications for the product quality system of start-up companies, which shortened the inspection time from 30 days to 6 days, and the inspection cycle was also shortened Half to one and a half months. At the same time, the implementation of innovative medical device product licensing approval and quality and quality system verification are carried out simultaneously. After the enterprise obtains the medical device registration certificate, it can obtain the production license as soon as possible.

The development of the medical device industry in Suzhou is jointly promoted by the Suzhou Institute of Biomedical Engineering Technology and the Suzhou Medical Device Research Institute of Southeast University. The Suzhou Medical Device Research Institute of Southeast University is jointly established by Suzhou High-tech Zone, Southeast University, and Jiangsu Industrial Technology Research Park. A "politics-industry-academic" model has been formed, and a product-oriented, joint technical team and enterprise joint development have been established to accelerate the process of product marketization.

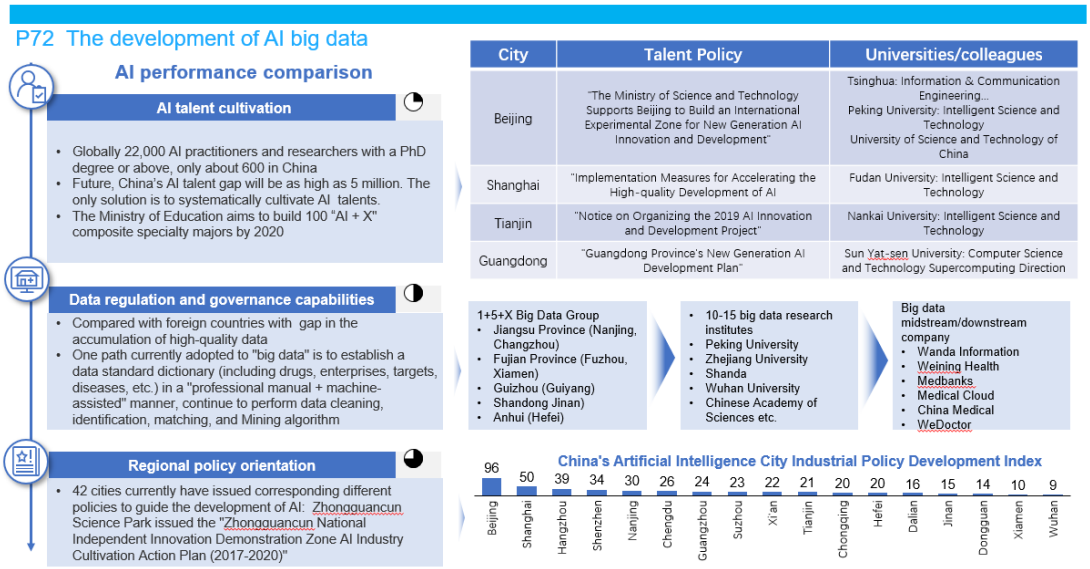
Shenzhen medical equipment mainly benefits from the leading company Mindray Medical. Based on the electronics industry, it has continuously explored its industrial research and development capabilities. The new digital imaging technology for clinical diagnosis and the preparation technology of new repair materials have been rapidly developed. At present, AI + medical equipment, medicine + Medical equipment and full-process innovation are constantly advancing.

4.5.2.4 Comparative analysis of urban medical service development

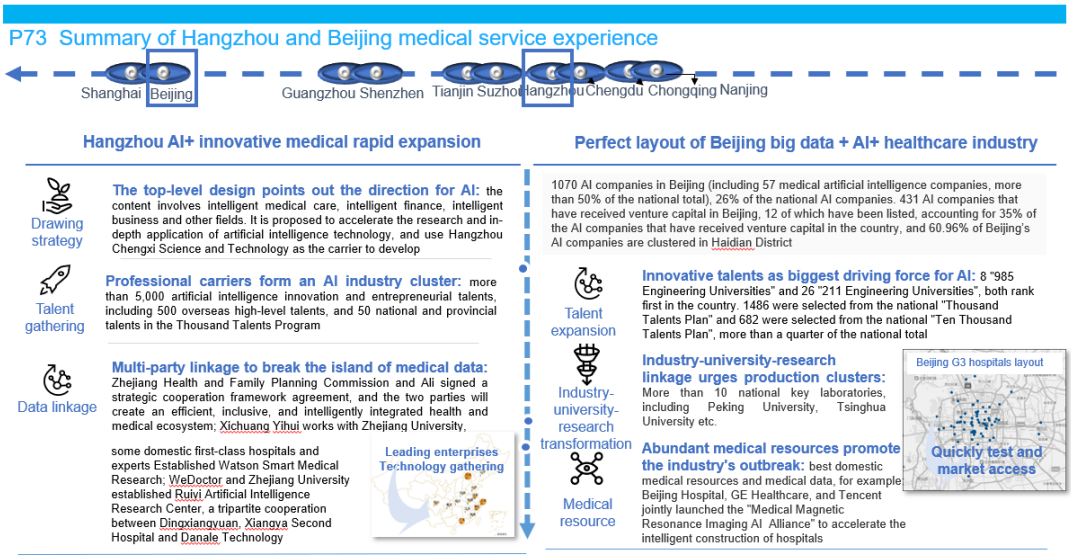
A. In innovative medical services, focus is on the development direction of CRO, payment and digitalization. Core cities are currently relatively mature in the field of CRO innovative R&D services, while innovative medical insurance payment has just started.



B. Take artificial intelligence as an example: the key core factors are artificial intelligence compound talents, policy support, capital investment, big data governance capabilities, and industrial chain layout.



C. Summary of development experience in Beijing and Hangzhou.



The development of Hangzhou's medical services is mainly reflected in the rapid expansion of artificial intelligence + innovative medical care. On the one hand, Hangzhou proposes a top-level strategic plan for the use of artificial intelligence technology in the development of intelligent medical, intelligent finance, and intelligent business. In addition, due to Ali's promotion of artificial intelligence talent accumulation and data Linkage has developed rapidly.

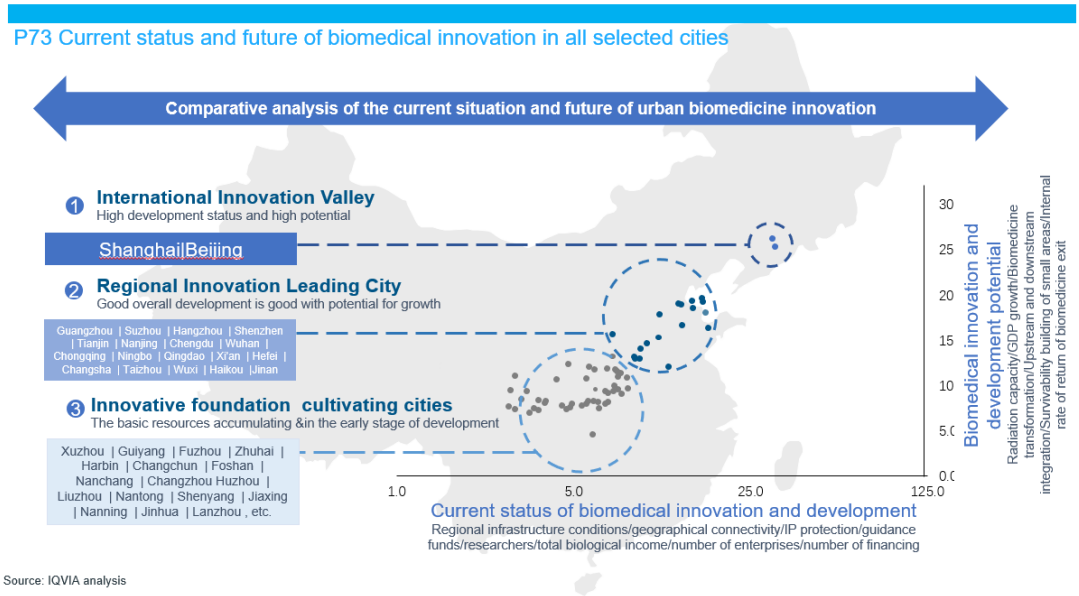
Beijing's medical services are mainly manifested in the comprehensive layout of medical big data + artificial intelligence + health care industry. The gathering of innovative talents, the transformation of production, education and research, and abundant medical resources have promoted the industry's explosion.

5. Suggestions for enhancing cities' biomedical innovation

5.1 Innovation and development suggestions

5.1.1 China's biomedical industry has formed three innovative cities' group

Through the analysis of the 6 major first-level indicators of the selected 72 cities, we compare the current status and future potential of biomedical innovation in all cities. We summarize the current biomedical industry innovation in the selected cities to form three major squares.



Source: IQVIA analysis

5.1.1.1 International Innovation Biology Valley——Take Shanghai and Beijing as typical representatives

- Typical characteristics: It is far ahead of other cities with domestic advanced R&D resources, complete innovation system and industrial construction, and corporate capabilities and overall income.
- Industrial structure: The international biomedical research and development center, radiating to surrounding areas, has initially formed industrial complementarity and interaction with surrounding areas, and has become a regional leader.

5.1.1.2 Regional Innovation Leading City——Take Guangzhou and Suzhou as typical representatives

- Typical characteristics: Overall development is good, with certain potential growth points
- Industrial structure: As a cluster center of the biomedical industry, the industrial innovation ability has been preliminarily highlighted, boosting the development of the urban biomedical industry.

5.1.1.3 Cultivating cities with innovative foundations——Take Dalian and Zhengzhou as typical representatives

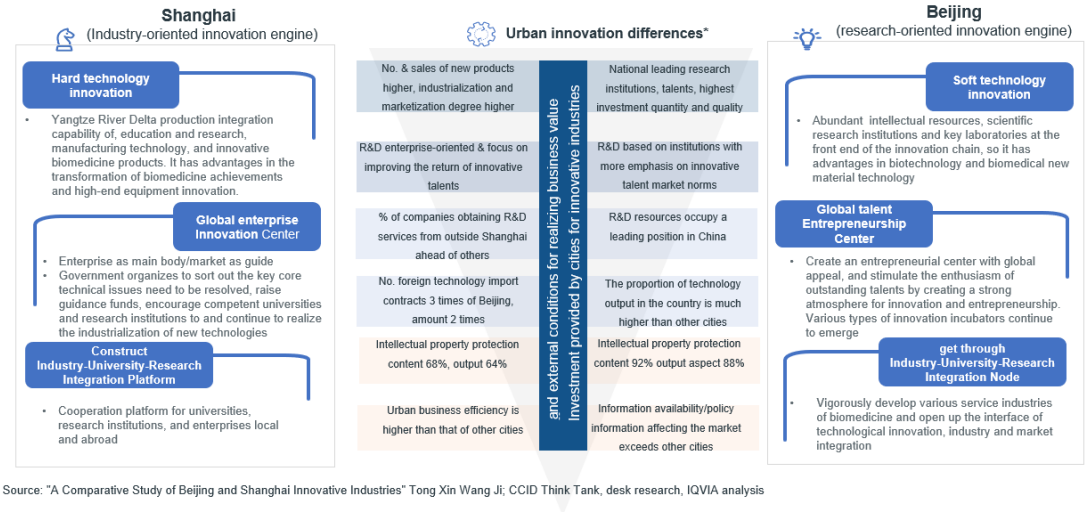
- Typical characteristics: Basic resources are accumulating and it is still in the early stage.
- Industrial structure: There is a certain biopharmaceutical industry foundation. The industry

innovation foundation and industry agglomeration are in the initial building process.

5.1.2 The largest square of innovative cities——international innovation engine

As a leading city in the country, Shanghai and Beijing have their own advantages in urban innovation elements, creating different international innovations for the biomedical industry. By comparing the investment provided by Shanghai and Beijing in the city for innovative industries and the construction of external conditions for realizing commercial value, we find that the innovation of Shanghai's biomedical industry mainly comes from enterprises, especially the strong ability of industrial transformation. Beijing has a high level of research and development resources in universities. In the case of concentration, it has great advantages in basic research and technical output.

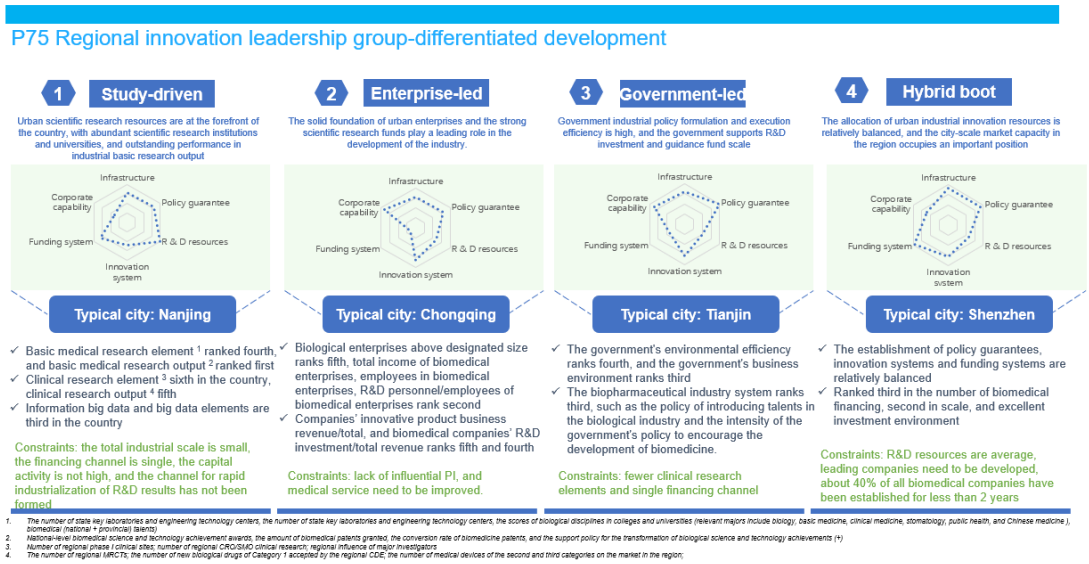
P74 Beijing and Shanghai-National Innovation Engines



Source: "A Comparative Study of Beijing and Shanghai Innovative Industries" Tong Xin Wang Ji; CCID Think Tank, desk research, IQVIA analysis

5.1.3 The second largest square of innovative cities-regional innovation leading city cluster

Through a detailed analysis of the six indicators of regional innovation leading cities and typical cities, the development rules and types of our developed cities are similar to those of developed countries' urban biomedical industry innovation experience. Therefore, regional innovation leading cities can be divided into different types, based on the unique industrial resources of the city, to allocate innovative resources, clarify the advantages of urban innovation and development, and realize differentiated and coordinated development.



Source: desk research, IQVIA analysis

5.1.4 The third largest square of innovative cities——Cultivating cities with innovative foundations

Urban agglomeration based on innovation is the largest urban group among the three phalanxes. There are 52 cities in total, 14 of which are provincial capitals. Some cities have shown their potential and are expected to enter the second phalanx.

Innovative foundation cultivating city group										
Overall ranking	Regional	City	if capital city	Overall Index	Infrastructure	Policy Guarantee	R&D resources	Innovation system	Financial system	Corporate Capabilities
21	Yangtze River Delta	Xuzhou		23.2	4.3	7.3	2.9	0.5	0.8	1.4
22	southwest	Guiyang	Yes	22.9	5.9	7.6	1.5	0.6	0.6	1.8
23	East China	Fuzhou	Yes	22.7	5.8	6.3	2.1	0.1	0.6	1.9
24	Yangtze River Delta	Lianyungang		22.6	4.0	5.8	2.4	2.5	2.3	1.5
25	East China	Xiamen		22.1	5.2	5.0	2.8	0.4	0.6	2.0
26	southwest	Kunming	Yes	21.6	6.1	4.9	1.6	0.5	0.3	2.1
27	Bohai Bay	Shijiazhuang	Yes	21.6	6.0	5.0	2.5	2.1	0.7	1.3
28	Greater Bay Area	Zhuhai		21.3	5.0	6.0	1.7	0.3	0.8	1.6

29	northeast	Harbin	Yes	20.5	5.6	5.7	2.6	1.3	0.6	1.8
30	northeast	Changchun	Yes	20.5	5.9	4.8	3.0	1.0	0.7	2.2
31	Greater Bay Area	Foshan		20.4	6.5	6.7	0.7	1.1	0.4	1.0
32	East China	Nanchang	Yes	20.0	5.2	5.6	2.0	0.8	0.7	1.8
33	Yangtze River Delta	Changzhou		20.0	5.4	5.5	3.0	0.8	0.8	1.5
34	Yangtze River Delta	Huzhou		20.0	5.3	7.6	1.2	0.1	0.8	1.0
35	South China	Liuzhou		19.3	4.7	6.6	0.4	0.0	1.0	1.5
36	Yangtze River Delta	Nantong		19.2	5.6	5.4	2.3	0.5	0.9	1.6
37	Bohai Bay	Shenyang	Yes	18.8	6.1	4.4	2.0	0.6	1.0	1.7
38	Yangtze River Delta	Jiaxing		18.7	6.1	5.5	2.2	0.0	0.9	1.1
39	South China	Nanning	Yes	18.6	4.6	6.7	1.3	0.7	1.0	1.4
40	Yangtze River Delta	Jinhua		18.5	6.5	6.0	1.9	0.0	0.8	1.2
41	northwest	Lanzhou	Yes	18.4	4.9	4.9	1.6	0.6	0.2	1.2
42	East China	Yantai		18.3	5.3	5.4	1.6	0.8	0.6	1.6
43	Yangtze River Delta	Wenzhou		18.0	6.0	5.2	2.1	0.1	0.8	1.8
44	Bohai Bay	Dalian		17.8	6.1	3.0	2.0	0.1	0.9	1.6
45	Yangtze River Delta	Taizhou		17.2	5.6	5.8	2.0	0.8	0.9	1.1
46	Central China	Zhengzhou	Yes	17.1	6.3	4.6	1.9	0.1	0.4	1.8

47	Yangtze River Delta	Shaoxing		16.8	5.5	5.5	1.0	0.6	0.9	1.4
48	Central China	Xinxiang		16.8	4.5	4.9	2.4	0.0	0.4	1.6
49	Greater Bay Area	Dongguan		16.7	5.0	6.0	0.5	0.8	0.4	1.0
50	East China	Linyi		16.4	4.9	4.8	1.1	0.3	0.6	1.7
51	Greater Bay Area	Zhongshan		16.2	4.6	6.3	0.5	0.9	0.5	1.5
52	East China	Ganzhou		16.2	4.6	6.3	0.2	0.0	0.7	1.4
53	East China	Weifang		15.8	5.2	5.0	1.6	0.7	0.6	1.7
54	Yangtze River Delta	Yangzhou		15.0	4.8	5.4	1.1	0.4	0.7	1.5
55	East China	Zibo		14.7	4.9	5.2	1.5	0.8	0.6	1.6
56	northwest	Urumqi	Yes	14.5	6.1	2.4	1.2	0.4	0.4	2.0
57	South China	Qionghai		14.5	3.3	4.5	1.1	0.0	0.8	1.8
58	Yangtze River Delta	Yancheng		14.2	3.9	5.1	2.1	0.0	0.8	1.3
59	East China	Texas		14.1	3.9	4.5	1.4	0.3	0.6	1.5
60	East China	Heze		13.9	4.8	4.7	1.4	0.0	0.6	1.5
61	Bohai Bay	Baoding		13.7	5.1	3.7	1.2	0.1	0.6	1.0
62	Yangtze River Delta	Zhenjiang		13.5	4.2	5.1	2.1	0.0	0.8	1.2
63	Central China	Yueyang		13.4	4.2	4.3	1.1	0.2	0.4	1.2
64	Bohai Bay	Tangshan		13.3	5.5	3.7	1.1	0.0	0.6	1.3
65	North China	Langfang		13.3	4.7	3.9	1.1	0.0	0.6	0.9

66	Yangtze River Delta	Wuhu		13.2	4.7	5.3	0.2	0.0	0.9	0.9
67	North China	Taiyuan	Yes	13.1	5.7	2.5	1.5	0.0	0.1	2.3
68	East China	Liaocheng		13.0	3.9	4.7	1.4	0.0	0.6	1.4
69	North China	Hohhot	Yes	12.6	4.0	2.9	0.5	0.2	0.7	1.3
70	Bohai Bay	Cangzhou		12.5	4.8	3.3	1.1	0.6	0.6	1.0
71	North China	Handan		11.5	4.8	3.6	1.4	0.0	0.6	1.0
72	Central China	Xuchang		11.4	4.6	3.7	1.1	0.0	0.4	1.5

5.1.5 Carry out global cooperation and build a national-level biomedical industry innovation system

The establishment of a regional and national biomedical industry innovation system is inseparable from the coordinated progress of all cities.

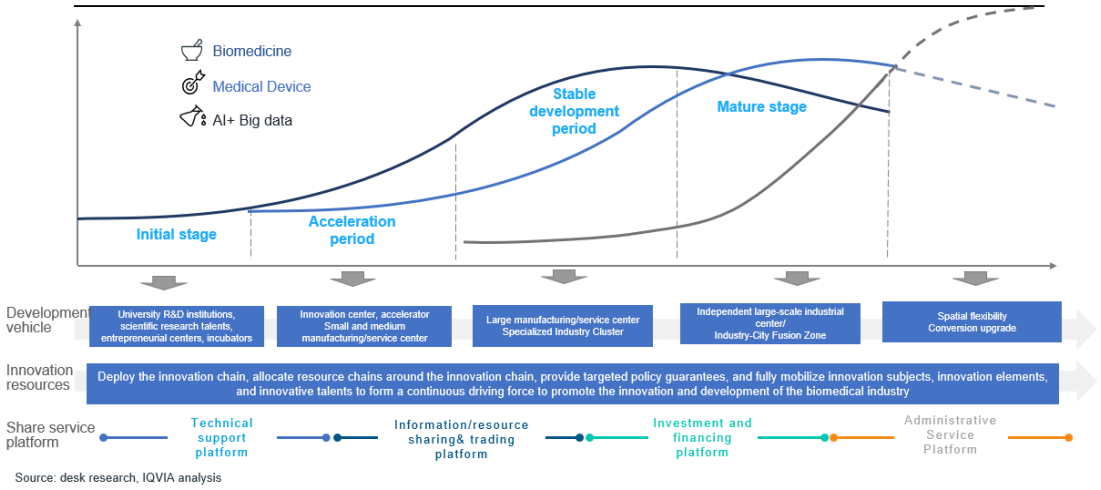
5.1.5.1 cooperation among the cities

Cities can seek to establish channels for the flow and transformation of technology, information, and products, carry out urban cooperation and innovation, and realize resource sharing and mutual development.

5.1.5.2 Urban industry life cycle cultivation

At the same time, each city must clarify the period of innovation and development, gather innovation resources in accordance with the current conditions, classify and guide the direction of innovation development, and create a sustainable driving force for the urban biomedical industry.

P77 Demands for innovative elements in the life cycle of urban industry development

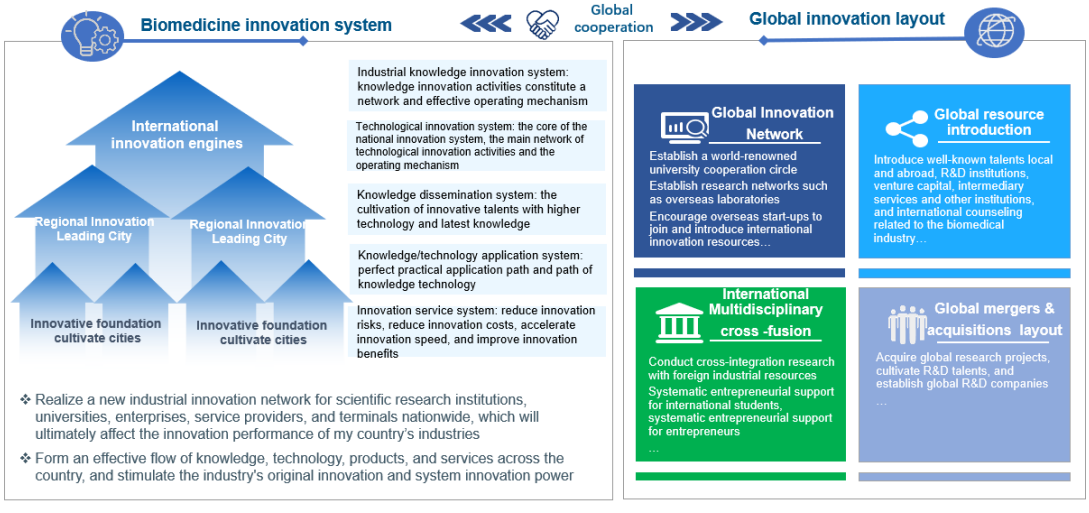


Source: desk research, IQVIA analysis

5.1.5.3 Urban Innovation system & Global Cooperation

Eventually, a national biomedical industry innovation system will be gradually formed and a global innovation layout will be carried out to achieve global cooperation and stimulate the original industry innovation and system innovation power.

P78 Biomedicine innovation system & global innovation layout

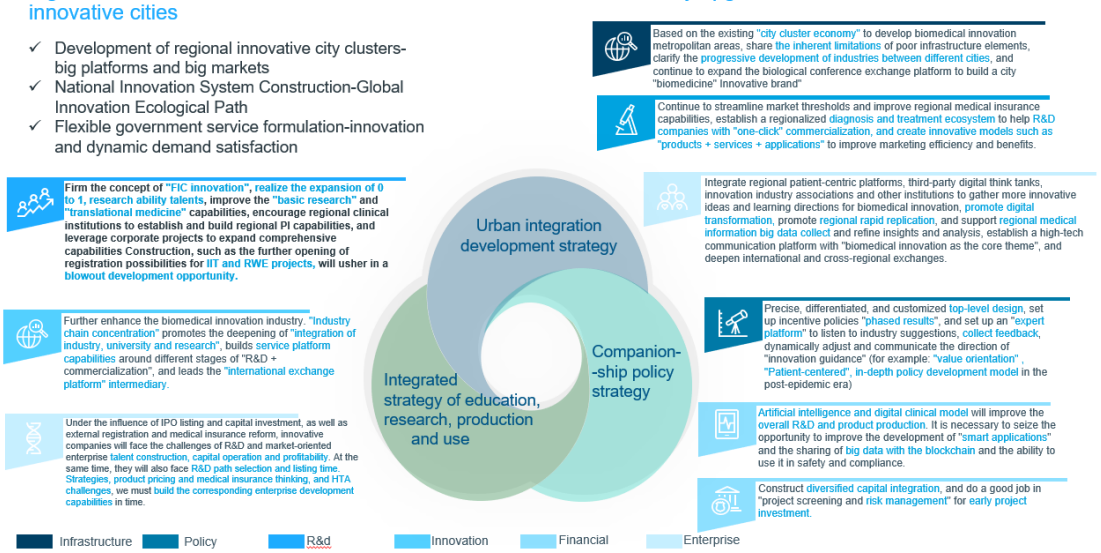


Source: desk research, IQVIA analysis

5.2 China's urban biomedical innovation strategy

In order to meet the big era of China's biomedical innovation industry upgrade, innovative cities can consider starting actions from the following three aspects, each of which is directly related to the six elements of urban innovation.

Figure 79 Welcome to the era of China's biomedical innovation industry upgrade: the direction of action in innovative cities



5.2.1 Regional innovative city cluster development

Drawing lessons from the development experience of the San Francisco Bay Area in the United States, we need to transform the closed endogenous development thinking to form a gradual open development strategy and a landing structure. The San Francisco Bay Area Innovation City Circle is the largest innovative city circle in the United States, including East Bay, North Bay, Peninsula, Oakland and San Jose, Silicon Valley, Stanford University, covering biomedicine, technical information, and finance. It has a total of 101 cities and 9 counties. The gradual construction of San Francisco includes looking for opportunities for the division of labor and coordinated development of urban industries, building a forward-looking transportation network in the metropolitan area, building various service functional platforms (risk financing platform, industry-university-research platform), and encouraging the relocation of colleges and universities for a long time, so as to improve the surrounding capacity.

The establishment of regional innovative city clusters requires strategic identification of linked cities, mainly based on the level of economic development, urban population size, transportation connectivity, and bio-industry capabilities, including the number of hospitals, the number of basic universities, the number of research and production talents, and enterprises quantity. At the same time, it is necessary to clarify the linkage methods and elements. The directions of mutual leverage between cities will be different. Some are radiation cities, and some are linkage cities. In the statistics of linkage cities and radiation cities, the quality of provincial capitals, basic medical level, medical scientific research level, basic medical development conditions and government support for medicine should be considered.

After clarifying the linkage strategy, it is necessary to build a linkage structure diagram, which includes four parts. The first is extension. It means that we need to expand downstream markets and shape city brands, use information technology, biomedicine and high-end medical

equipment and other innovative marketing concepts, and provide services and product to integrate patient diagnosis and treatment. The second is recruiting. To be specific, we should launch cooperation with universities, build a quality brand in innovative metropolitan areas through the “Internet + medical care”, and realize the transformation of traditional into "high-quality innovation". The third one is investing. In the form of industrial funds, we will promote mass entrepreneurship and innovation in science, technology and finance, with industry as the main body, and deepen the technology and quality of innovative drug production. The fourth is innovation. We should build an inter-city incubation platform and shared service platform to realize an innovative urban metropolitan circle driven by innovation, intelligent production, and integrated supply.

5.2.1.1 Leveraging on the development trend of urban agglomerations

Explore the "Innovative City Center". The inherent limitations of the poor sharing of the elements of urban innovation infrastructure have gradually emerged, and the closed endogenous development thinking should be changed.

At present, the more mature metropolitan areas in my country take the Yangtze River Delta and the Greater Bay Area as examples, and the catch-up metropolitan areas take Beijing-Tianjin and Chengdu-Chongqing as examples. Other metropolitan areas are still in the growth or cultivation stage. The Yangtze River Delta integrates the most developed cities and towns such as Wuxi, Nantong, Suzhou, Ningbo, Hangzhou, Nanjing, Hefei and Changzhou. It has a high degree of agglomeration and concentrates 20% of the total economic output. However, the current global influence can be further improved. The synergy is better in Shanghai, Hangzhou, Nanjing, Suzhou and Ningbo, and other regions can be further improved. The core cities of the Greater Bay Area, Guangzhou, Shenzhen, Hong Kong, Macau, Dongguan, Zhuhai, Zhongshan, and Foshan, have formed good industrial synergy and "resonance" and "step-type", and the supporting facilities of public facilities attract overseas high-end technology talents. Beijing-Tianjin-Hebei is currently positioned as a catch-up metropolitan area. There is room for improvement in the connectivity between basic transportation and surrounding areas (Hebei), and the current development of secondary cities is quite different from that of Beijing and Tianjin, with insufficient radioactivity. In addition, the current industrial division of labor with neighboring provinces and cities is not clear, and there is room for further optimization of industrial chain links. In the Chengdu-Chongqing area, the dual centers, Chengdu and Chongqing are linked together, and the large logistics is directly connected to Central Europe, the east and other places. The overall development is relatively early, and a "large-medium-small" ladder needs to be formed, and a complete service and ecological circle must be built.

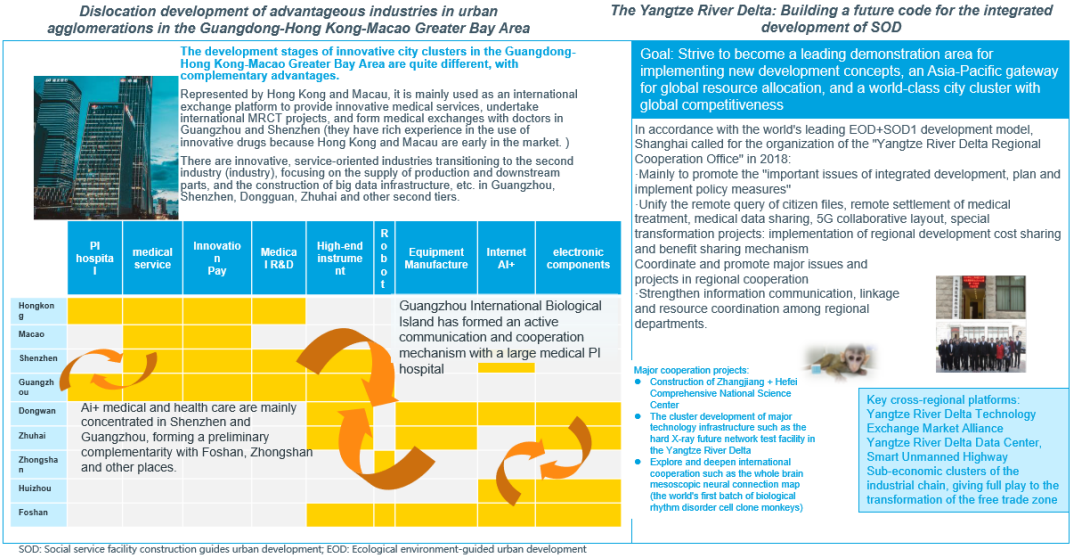
For a city in the center of the biomedical innovation metropolitan area, to play a leading role in driving the development of the innovative metropolitan area industry, certain development conditions are required, such as basic conditions including an urbanization rate >50%, and a developed economy with a cumulative annual GDP growth rate of about 5%. Also, the transportation system should be well-developed, commuting to cities and provinces is less than 1-2 hours, and the GDP of surrounding radiating cities contributes about 40%. At the same time, the corresponding biomedical market is sufficiently strong, with certain biomedical industry and basic medical elements. Take the Yangtze River Delta Prefecture as an example. In 2018, its GDP was 17.8 trillion-yuan, accounting for 20% of the country. Small and medium-sized cities’ GDP

was 7.1 trillion yuan), accounting for 40% of the metropolitan area. The development of the biomedical innovation metropolitan area will help overcome the limitations of some of the basic capabilities of the city's innate biomedicine, such as PI, hospitals, colleges, etc. It is conducive to the maximization of the use of public resources. It is also conducive to industrial resonance to achieve regional collaborative high-quality innovation development, carrying the main carrier of global competition and cooperation, and providing overall international influence.

5.2.1.2 Case study

A. At present, the Guangdong-Hong Kong-Macao Greater Bay and the Yangtze River Delta have begun to gradually break through the small pattern of "industrial clusters" and accelerate their integration into the urban agglomeration economy.

Figure 80 Development of the Yangtze River Delta Innovative Metropolis in the Greater Bay Area



B. Establish a regionalized diagnosis and treatment ecosystem, help innovative companies to commercialize with "one-click", and create an innovative business model of "product + service + application" to maintain long-term competitiveness.

Large companies would not talk about the incubation. Many small and innovative companies that focus on R&D need business success, but they lack a series of marketing, management, service, capital and other guidance besides R&D, so they provide a full range of Shared services for innovative companies on the platform through building an integrated business capability innovation platform covering the life sciences. The service includes laboratories and equipment, platforms and services, and innovation sharing communities. It can not only accelerate the growth of innovative companies, but also provide global innovation wisdom. Chinese patients provide innovative solutions to improve their lives, covering the full cycle of life sciences and the entire course of disease management. At present, some innovative companies are developing rapidly with the assistance of AstraZeneca (i-campus). They have initially built up their operational competitiveness, initially realized the aggregation of the industrial chain, and partly realized the coverage of the front, middle and back ends of the patient-centric whole-process innovation.

Through the creation of an innovative metropolitan area, the gradual establishment of a

regionalized diagnosis and treatment ecosystem can create a platform for biomedical startups to enhance product commercialization capabilities, increase capital utilization, and increase commercial output. We could provide a unified business environment of optimized product + service combination mode for growing biomedical enterprises and promote the upgrading of their business model based on product combination and service, so as to further strengthen the cooperation between industry, enterprises and upstream and downstream. Besides, we should realize digital application diagnosis and treatment ecosphere in the region, realize timely detection of patient needs, promote resource optimization, and lay a foundation for further opening and cooperation.

5.2.2 Integrated strategy of education, research, production and use

Learn from the experience of Texas Medical Center, Asan Medical Center, and Duke Research and Transformation Center, we should encourage the construction of regional basic research and drug discovery platforms, promote the construction of clinical trial institutions, the PI cultivation system for regional research sub-centers, and build a complete transformation platform and Technology trading market.

Figure 81 Experiences of Texas Medical Center, Asan Medical Center, and Duke Medical Center

5.2.2.1 Establish a closed-loop transformation of the entire industry chain

We can see from leading industrial parks or medical institutions abroad that to realize the biomedical industry from basic research to clinical trials to industrialization and commercialization internationalization, it is necessary to establish research and development, clinical, medical and data transformation systems covering the entire industrial chain, construct a closed loop of medical transformation, accelerate the clinical transformation of research results, and assist the "industry" to move toward an international platform.

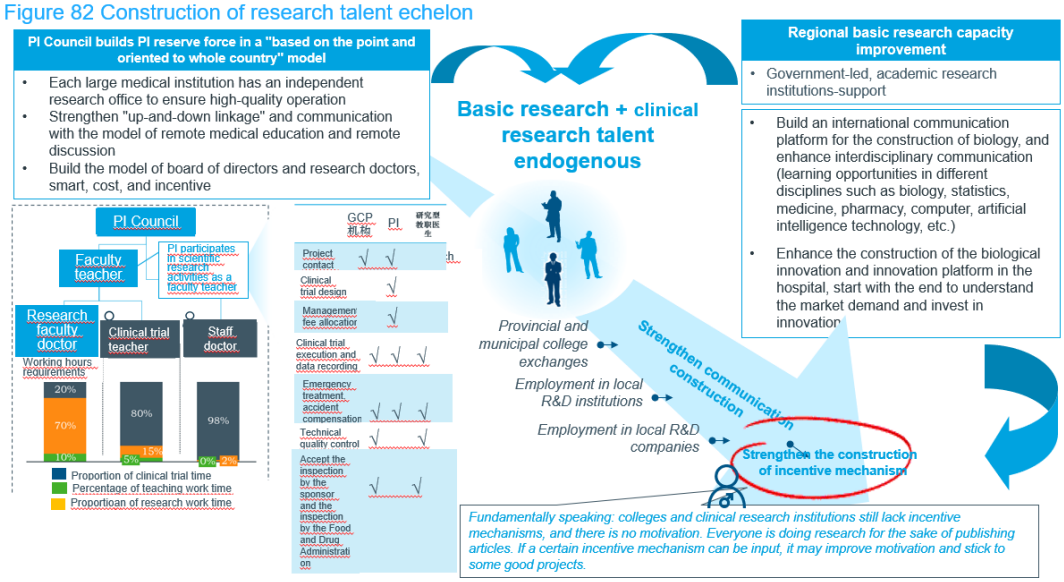
It is necessary to establish a closed loop of patient-centered R&D and application transformation, and construct a direct closed loop from academic R&D institutions, incubator accelerators, medical clinical service institutions, small biomedical companies to giant biomedical companies, and then backfeed academic research institutions through giant biomedical companies. It is necessary to establish a closed-loop clinical transformation application centered on merging patients, and integrate drug device R&D institutions, clinical trial companies, and

shared testing centers into a regional clinical service platform to lay the foundation for the transformation of clinical needs into innovative drug devices. Through cooperation with top international medical institutions, medical service platforms, medical device manufacturers, and medical talents are integrated and shared resources, and a closed loop of patient-centered medical transformation is established. At the same time, we must also pay attention to the creation of closed-loop data conversion applications for medical big data and artificial intelligence to further empower other closed-loops.

At the same time, the dissemination of knowledge and technology can bring new inspirations and new ideas. Therefore, the basic research institute, international conference center, telemedicine center, and authoritative medical media will become a powerful closed-loop communication service platform for the transformation of the entire industry chain. A developmental biomedical innovation chain is built in a closed loop.

5.2.2.2 Build a stepped basic research talent

Figure 82 Construction of research talent echelon

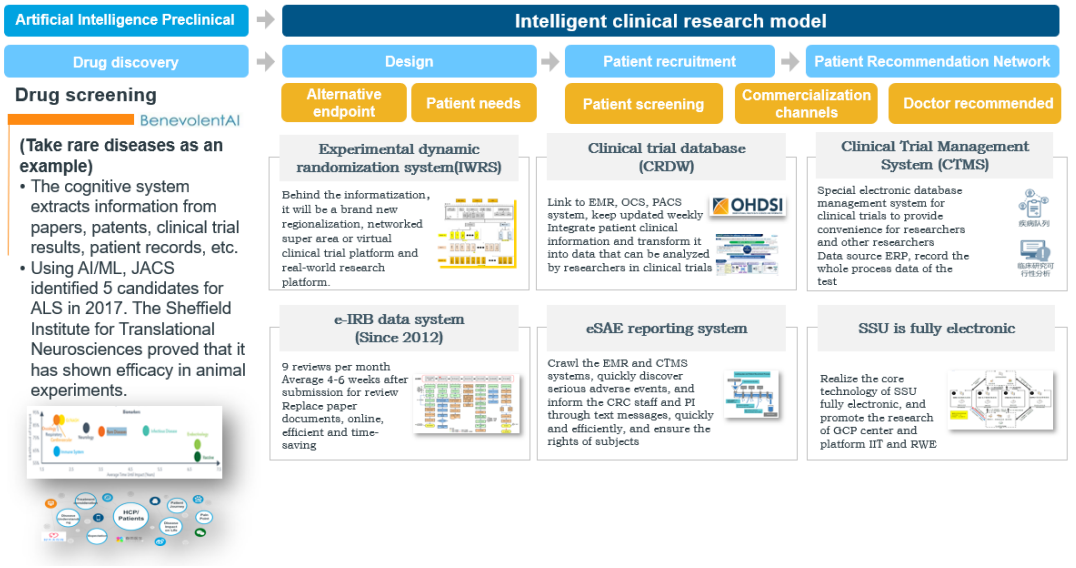


We should construct stepped basic research talents and motivate clinical medical research talents, and at the same time cultivate regional PI capabilities when expanding the construction of GPC hospitals, to reserve forces for later research. Also, we need to build the PI reserve force based on the PI board of directors' "point-to-surface" model, continuously improve regional basic research capabilities, form basic research + clinical research talent endogenous force, and send research with clinical practical experience to universities, R&D institutions, and R&D companies Personnel, and the design of a reasonable incentive mechanism to mobilize the enthusiasm of all parties.

5.2.2.3 Use artificial intelligence and digital model clinical

Artificial intelligence and digital clinical model will improve the overall research and development and product production, and we need to seize the opportunity to improve "intelligent applications". Artificial intelligence can be used not only in drug discovery, but also in program design, patient recruitment, an efficient patient recommendation network built, digital clinical trials built, and the efficiency of R&D transformation improvement.

Figure 83 Clinical research application of artificial intelligence



5.2.2.4 Case analysis

A. At present, various types of "integrated" basic medicine, early R&D services, and prototype clinical management center platforms have begun trials in leading regions of the country and have been carried out in an orderly manner in the Chinese market.

The "integrated" basic medical exchange platform, through the establishment of a multi-directional basic medical exchange platform centered on enterprises, internally builds opportunities for urban R&D talent resources, builds multiple R&D centers of different types and different directions. External R&D institutions are set up in developed countries such as the United States, Japan and the United Kingdom. They have established a global integrated network research and development platform that uses domestic bio-industry parks as an exchange platform to carry out international colleges and international cooperation projects in many places.

The "integrated" early R&D industry service adopts the model of "VC+IP+CRO+Quality" to realize the organic combination of "VC, IP, CRO and Quality", and build multiple important service platform environments for the drug R&D and marketing process. Also, this service could create the path of new drug screening, process route, quality research, pharmacological efficacy research, pharmacokinetic research, safety evaluation, clinical research, pilot scale up, and registration application.

The "integrated" clinical management system is mainly based on the "digital clinical research management and application" model. Beijing, Shanghai and Guangzhou (The Second Affiliated Hospital of Guangzhou Medical University) are currently beginning to try information technology systems to provide "integrated" management solutions for clinical research center service platforms, covering disease cohorts, clinical research feasibility analysis, pre-screening the number of eligible patients, efficient and rapid screening, GCP approval verification, and the entire process of real-world research.

B. First in class new drugs conducted feasibility path discussion and experience sharing

In September 2020, at the "China Development of First in Class New Drugs" forum held in

Hangzhou Qiantang New District, more than 20 R&D presidents discussed the feasibility of developing First in class drugs in China and shared their experiences.

- Global potential first-in-class innovative drugs introduced from basic drug R&D centers such as international companies, research institutions and universities.
- With the help of international research experience, keeping up with cutting-edge targets, in-depth characteristics, including different mechanisms and technology types, and considering other collaborative signal pathways for development. After selecting targets, using systems biology methods to explore different indications and carrying out differentiated development.
- Dig into the main pathogenesis of established diseases in clinical medicine, and develop projects with basic universities and research institutes.
- Based on the drug development database in the global disease field, more R&D pipelines will be expanded after linking to more databases.
- Based on AI technology, the rapid de novo generation model of multiple disease molecules, activity and drugability prediction technology form a complete virtual screening system, looking for a starting point for the early discovery of First in class drugs.
- The establishment of a basic patent protection network, the layout of patents for each project, the layout of key products, become one of the innovative drug development process.
- ...

C. The transformation experience of scientific research achievements of Westlake University

West Lake University, as a new non-profit college of higher education supported by the state, has completed the first transformation of scientific and technological achievements and provided a new definition of "industry-study-research". West Lake University is a new non-profit higher education institution organized by social forces and supported by the state. The subordinate West Lake Biomedicine includes expert committee director: Wang Tingliang; on-campus expert members: Guo Tiannan, Shi Hongjun, Sun Yi, Tang Hongyun, Wang Yalin; off campus Experts: Hu Hailan (Zhejiang University); Liu Wanli (Tsinghua University) and Shi Songhai (Tsinghua University), build a medical doctor-based transformation team, whose main responsibilities are to set up a commercial team, analyze technology scenarios, and negotiate investment People, institutions, and government funds. From patent applications, legal consultations to investor negotiations, the Achievement Transformation Office is involved in preclinical projects such as lung cancer, cervical cancer, lung cancer, new crown vaccines, immunity and metabolic diseases.

West Lake University's first scientific and technological achievement transformation project is red blood cell therapy, which has completed nearly 100 million yuan of Pre-A round of financing. It is also a personalized new red blood cell therapy technology from Gao Xiaofei's "stem cell and organ regeneration" laboratory, which can be used to treat gout and hemophilia Disease, phenylketonuria and other rare diseases and even cancer.

An "auxiliary track" was quietly launched at the beginning of the project. From patent application, legal consultation to investor negotiation, the Office of Achievement Transformation participated in the whole process, which greatly accelerated the speed of project implementation. As a pilot for China's higher education reform, West Lake University has incorporated the "transformation of scientific research results" into its innovation category from the very

beginning and successfully achieved the transformation of scientific and technological achievements in just two years.

D. Achievement transformation experience of Shanghai Institute of Materia Medica, China Science Park

As the core difficulty of "transformation of results" in the promotion of biomedical technology, Shanghai Pharmaceutical Research Institute has issued experience, and has continuously improved the construction of "transaction platform" and continued to encourage innovation.

In 2015, the Institute began to clarify the rights and interests of achievement transformation to improve the technology intermediary service system, clarify that the disposal rights of achievements are assigned to teams or individuals, increase incentives for scientific research teams, and allow not less than 70% of the transformation income to belong to the team. It also carry out "Loss" exemption policy, establish a market-based pricing mechanism, encourage scientific research institutions to set up special work offices, or entrust third-party technology transfer service agencies to carry out work, develop technology international markets (technology transfer networks, serve universities, academic institutions), and accelerate the development of intermediaries business.

From 2017 to 2020, based on the 2015 version, the person in charge implemented the action plan. As a national-level scientific and technological achievement transfer and transformation demonstration zone, it implemented the action plan:

- Enhance the endogenous power of the transfer and transformation of scientific and technological achievements
- Establish a joint conference on the transfer and transformation of scientific and technological achievements under the leadership of the municipal party committee and municipal government
- Efficiently stimulate research and development institutions, carry out research and development cooperation, transfer licenses, buy shares, start companies and other forms of transfer and transformation of scientific and technological achievements
- Fully release the needs of enterprises for the transfer and transformation of scientific and technological achievements: support enterprises to explore models such as "R&D crowdsourcing"
- Establish an open and shared information database of scientific and technological achievements
- Build a service system for the transfer and transformation of scientific and technological achievements
- Optimize the transfer and transformation ecosystem of scientific and technological achievements

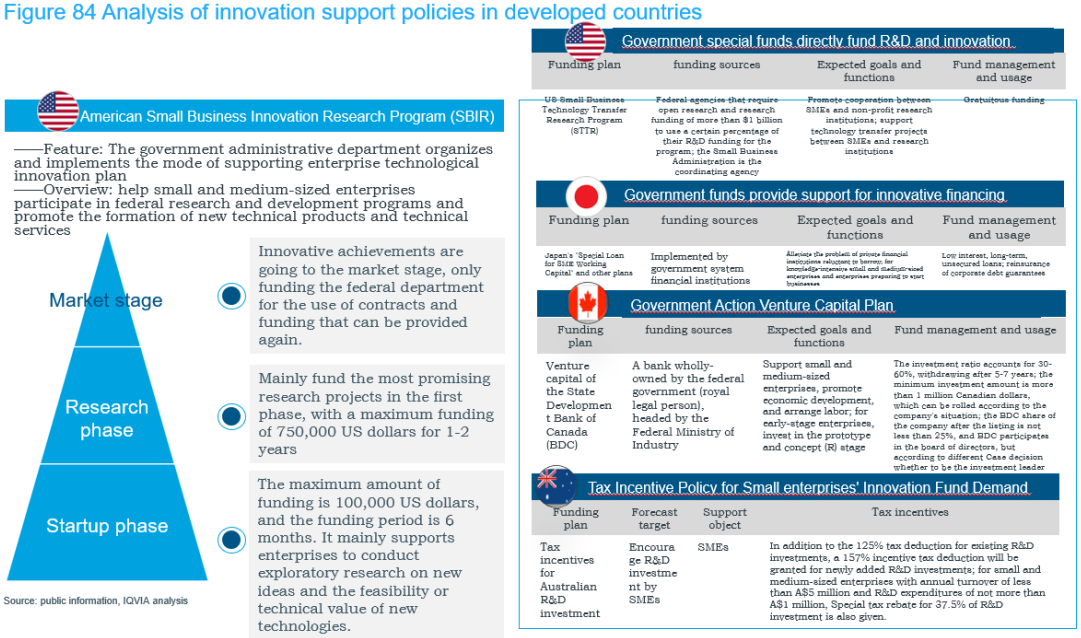
At the end of 2016, inspired by the conversion of scientific and technological achievements, the current results of the conversion income have begun to take effect. Achievement transformation projects and the amount of money have increased rapidly. Between 2010 and 2014, there were 13 accumulated transfer results, with an amount of only 800 million yuan. In 2015, 15 new drug R&D achievements were successfully transferred, with a total contract value exceeding 800 million yuan. In the past, the down payment for transfer projects was only 5-10

million yuan. In 2015, there were transfer projects with a down payment transaction value of 30 million yuan. Several new drugs have entered the clinical research phase. In 2015, five new drugs of category 1.1 chemical drugs have received clinical approval. At present, Shanghai Pharmaceuticals has a total of 10 new drug candidates entering clinical research.

5.2.3 Companionship policy strategy

Learn from the government experience of developed countries and formulate a series of policies and support for different development stages and different levels based on the needs of enterprise innovation research.

Figure 84 Analysis of innovation support policies in developed countries

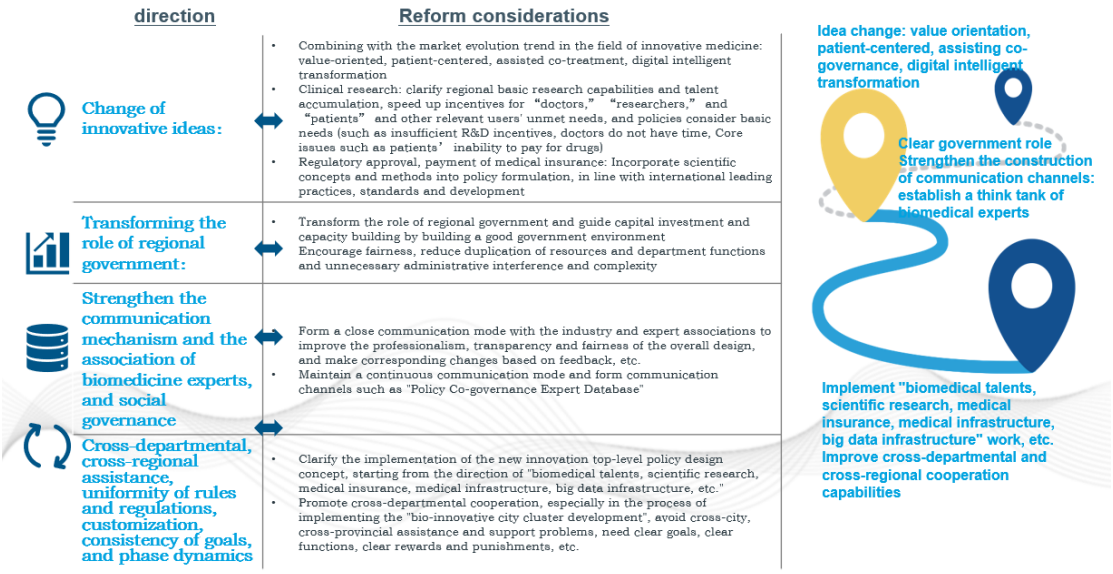


With the United States Small Business Innovation Research Program (SBIR), the government administrative department organizes and implements a support enterprise technology innovation program model to help small and medium-sized enterprises participate in federal research and development programs and promote the formation of new technology products and technical services. Research funding covers the start-up phase, R&D phase, and market phase, and provides a life-cycle companion funding program for the innovation of American small and medium-sized enterprises. At the same time, to learn from the experience of different countries, it is necessary to construct a venture capital plan that directly subsidizes the R&D and innovation of small and medium-sized enterprises, support the innovation financing of small and medium-sized enterprises with government special funds, and conduct a tax incentive policy that supports the innovation capital demand of small and medium-sized enterprises to provide multi-level capital representation for innovative enterprises.

5.2.3.1 Establish companionship policy

First, the top-level design of policies and services is the foundation of the sustainable development of biomedical innovation, starting from the promotion and transformation of ideas. Secondly, policy formulation and services have evolved from a point-like decentralized layout to a flexible companion service, which dynamically meets the needs of different development stages of the industry.

Figure 85 Policy-making, innovative concept changes



- Policy formulation from service companies to service industries, not only focusing on leading companies, but also focusing on small and medium-sized enterprises as the main innovation body, practically helping enterprises from the height, depth, and breadth of the business, creating an industrial ecology in which leading companies lead small and medium-sized enterprises. In the process of urban research, we found that most cities have no difference in policies between leading enterprises and small and medium-sized enterprises. Small and medium-sized innovative enterprises and leading enterprises need completely different support in the R&D stage. Therefore, we must start from the industrial development. From the perspective of different enterprises, we should formulate corresponding policies.
- From the profit model to the ecological model, industrial services must be an ecological model for companies in the industrial chain to make the cake bigger and win-win together. Industrial services must be upgraded from a single-point profit model to a multi-point profit for the entire ecological cycle to construct a business ecosystem diversity, reshaping the organization's operating model and business structure. In the process of urban surveys, some cities, on the one hand, the biopharmaceutical industry is in the early stage of development, focusing on small and medium-sized innovative R&D enterprises, on the other hand, the assessment of output value and taxation is imminent, which will inevitably lead to low-quality innovation and focus on homogeneous development.
- Integrate resources to form ecological operations, penetrate into the business process of enterprise organizations through professional services in the industrial field, and provide financial and informatization support for industrial project companies through a network of partners, and ultimately form a community of interests and a shared destiny for the industrial economy living body. During the research process, some cities' industrial services were very scattered, and a lot of attention was paid to the introduction of enterprises and the output of results. However, in the research and development process and the later stage of marketization, they basically rely on their own capabilities.
- From operation-driven to technology-driven, some cities lack professional industrial operation teams. Data intelligence is urgently needed to drive business collaboration and

break information islands and resource allocation restrictions. Through the application of digitization, the overall upgrade of the operating model is realized, the sharing of internal resources, the dissemination of market information, and the continuous improvement of organizational operations and business operation processes are continuously improved, reducing the requirements for personnel capabilities and shortening the learning cycle. In the process of urban research, we found that there is a gap in the integrity of the biomedical enterprise data. It is impossible for the department to conduct statistics, analysis, and research. To a certain extent, it is difficult for the industrial park management or market operators to understand the biological industry in the region. The overall situation of the development of pharmaceutical companies is not known for many of their needs.

- Introduce professional service institutions in the industrial value chain, financial and information institutions and business platforms in the industrial ecological chain to form a complementary and enhanced system of strong alliances. In the process of urban research, we found that when companies were introduced in cities, we paid much attention to biomedicine R&D, manufacturing, and production companies, but paid less attention to specialized service companies serving these companies. Therefore, when building a complete service platform, there is a lack or break in the service chain.

5.2.3.2 Case analysis

A. At present, innovative small and medium-sized enterprises urgently need early start-up funds, establish a seed fund led by regional government affairs and encourage enterprises to carry out early cooperation, to motivate diversified investors to invest in early R&D projects.

Introduce the construction of regional government seed research funds, set up a unified planned regional research and development fund, set up a professional management team (scientist certification) in different fields for management and approval (application for openness and transparency, conditions and information disclosure), and government funding are above 75%-85% (Or the regional government plays the role of fund of funds, decentralized management evaluation mechanism to incubator management), and private investment are about 15%.

Strengthen the construction of incubator projects, undertake government fund management, provide guidance to selected enterprises, hold seminars and promote exchange platforms.

Introduce early-stage cooperation with companies, such as the "Roche Gastrointestinal Tumor Immunity Combined Therapy Cooperative Special Program". Specific support methods include but are not limited to providing Chinese pharmaceutical companies with Roche tumor immune products and research drugs, through cooperation with domestic innovative pharmaceutical companies. Under the agreement, Roche will provide R&D funds, scientific and R&D support to help it optimize strategies and accelerate the R&D process. Start Roche’s early R&D with Chinese research institutions and local innovative companies Cooperation.

Establish investment confidence and screening project standards, and risk management capabilities. Among the tens of thousands of investment institutions in China, those that really have their own clear early project investment logic may only account for 2%. The current investment logic has three key words: frontier, innovation and future. To be specific, it mainly focuses on the potential track (professional) and corporate talent background.

B. The government promotes the digital transformation of biomedicine, breaks down administrative barriers, and refines insights from R&D, production to commercial operation, which will help innovative initiatives improve efficiency and success rate.

The digital medical economy involves one-stop digital applications (AI R&D, AI medicine, Internet hospital promotion, cloud conference, WeChat promotion model). Digital transformation involves digital infrastructure, internal and external data integration, data promotion experiments, and data promotion and transformation. The digital infrastructure construction involves medical insurance, medical care, medical data accumulation, digital channel construction and selection (5G), and doctors and patients' digital behavior data accumulation. Internal and external data integration involves digital information architecture and sorting, digital channel integration, regional user digital platform and integration, standardization, linking and other tasks. All of these must be achieved with the participation of the city government and coordination of the interests of all parties to achieve a comprehensive digital innovation economy.

6. Conclusion

In 2008, the "Major New Drug Development" special science and technology project was launched. In October 2017, the two central offices issued the "Opinions on Deepening the Reform of the Review and Approval System to Encourage Innovation in Drugs and Medical Devices". The human system, the International Technical Coordination Committee for Drug Registration for Human Use (ICH) has joined.... The new drug R&D ushered in the best era.

From raw materials to low-end preparations to high-end preparations, China's pharmaceutical innovation has climbed step by step and entered the "fast lane" of development. More and more domestic and foreign capital is pouring into the field of domestic new drug research and development. More and more medical elites local and abroad choose different cities to start their own entrepreneurial roads. Many powerful innovative pharmaceutical companies are emerging in various cities across the country.

History heralds the future, and the times bred opportunities. With the rise of cutting-edge technologies such as molecular biology technology, gene sequencing technology, medical imaging technology, artificial intelligence technology, and big data technology, China's bio-pharmaceutical industry is facing not only domestic opportunities, but also a great opportunity for global bio-economic development. It is not only an opportunity for innovative drugs, but also a great opportunity for global innovative medical service products. As the main responsibility of the biomedical industry, cities in China can only continue to develop new directions for the development of education, disciplines, scientific research, industry, markets, supervision, regional integration, and global cooperation in order to continuously develop good drugs, new drugs, new technologies, and new technologies. Service can truly build my country's status as a strong country in the global biomedical industry and forcefully enter the world stage.

7. Appendix: Top 10 biomedical innovation cities in China

7.1 Shanghai

As a mega city, Shanghai is a leader in the Yangtze River Delta and it is also a global biomedical research and development center. At present, Shanghai has formed a spatial pattern of the biomedical industry called" focusing on Zhangjiang, with one core area and multiple other areas", with Zhangjiang as the core, and Jinshan, Fengxian, Xuhui and other parks as the focus. Also, it focuses on subdivisions such as bio-medicine, medical equipment and medical services. In the future direction, Shanghai will continue to maintain cross-regional radiation capabilities and clustering of upstream and downstream companies in the industry and continue to build an international exchange platform.

7.1.1 Infrastructure

The core focus of Shanghai's infrastructure construction is to strengthen the construction of the international exchange platform and the improvement of its own internationalization capabilities, with stable growth and a leading position. It is a transportation hub local and abroad with developed transportation. It has strong innovation capabilities and attracts many multinational biomedical companies. It has rich medical resources. In recent years, the overall medical resources of high-tech exhibitions are ranked 1st and 2nd. There are about 50 public tertiary hospitals with 3 practicing physicians for every thousand people, and the output value of bio-medicine is as high as 88 billion yuan.

7.1.2 Policy guarantee

The Shanghai Municipal Government actively guides entrepreneurship and has established a relatively high entrepreneurial guidance fund. The accumulated government and park awards for biomedical development are about 60 million yuan/product, which is the largest in the country. At the same time, the municipal government has increased its protection of intellectual property rights, encouraged biomedical research and development and promoted the introduction of talents. 30% of the national research and development expenses are invested in Shanghai, and the introduction of biological talents is rewarded about 4 million yuan. There are now as many as 7 breakthrough biomedical innovation.

7.1.3 R & D resources

Shanghai has a sufficient reserve of national and provincial talents, with close to 80 outstanding young talents in bio-medicine and about 1,000 authorized biological patents, 48 clinical centers, and 51 regional PIs. Shanghai ranks second in the national biological subject score, and ranks third in the number of new biological drugs accepted by CDE. At the same time, Shanghai has two "most" in bio-medicine. To be specific, it has the most key laboratories, engineering technology centers, and has carried out the country's most MRCT experiments.

7.1.4 Innovation system

In terms of innovation system, Shanghai has created a development pattern of "focusing on Zhangjiang, paying attention on other areas", in which Zhangjiang, Zizhu, Minhang Economy and Caohejing emerging technologies have entered the top 100 industrial parks. As the core point, Zhangjiang has gathered 40 central R&D groups, more than 300 R&D enterprises and more than

40 CROs. Its scale of output value ranks second in the country. As far as the entire Shanghai biomedical industry is concerned, the city has established more than 100 upstream and downstream enterprises, incubated more than 2500 R&D companies, and launched international incubation projects with Israel, the United States, Russia, Singapore and other countries. Shanghai's animal companies ranked top two in the country.

7.1.5 Financing capacity

Shanghai's overall fund management system and financial service level are relatively high. The amount and scale of financing in the bio-pharmaceutical industry ranks among the top, and its financing diversification ranks No.1. According to the 2019 China City Business Environment Index Evaluation Report, Shanghai's Business Environment Index is 86.73, ranking first in the country.

7.1.6 Corporate capability

Shanghai provides an excellent policy support environment for small and micro enterprises through tax exemption and incentives. The bio-pharmaceutical enterprise capacity ranks in the top 3. Among the top 500 companies in the pharmaceutical industry by main business income in 2018, Shanghai has 31 companies on the list. At the same time, The C-level management talent background in Shanghai ranks first in the country, and the average biomedical research and development investment accounts for 8% of the total business revenue.

7.2 Beijing

Beijing's biomedical industry has shown a steady upward trend in recent years: relying on the industrial carrier of Zhongguancun's "1 District and 16 Parks", it radiates the surrounding Bohai area and focuses on the fields of bio-medicine, medical equipment and medical services. In the future, Beijing will actively create two major industrial clusters of "Basic R&D in the North and High-end Manufacturing in the South", guiding the centralized layout of enterprises and projects, and further enhancing the advantages of high-end manufacturing.

7.2.1 Infrastructure

As the national capital, Beijing's economic operation has been steadily improving, and the growth rate of the medical and health industry has increased steadily. Beijing's medical resources are concentrated. The number of public tertiary hospitals ranks first in the country. The number of practicing physicians is 5 per thousand people, and the total revenue of the pharmaceutical manufacturing industry is approximately 115.3 billion yuan. In terms of the number of high-tech exhibitions, Beijing ranks first in the country.

7.2.2 Policy guarantee

Beijing's top-level bio-medicine industry has a relatively complete design and has a breakthrough biomedical innovation policy. It actively encourages entrepreneurship and has a relatively high entrepreneurial guidance fund. The government entrepreneurship guidance fund ranks second, and the cumulative government award for biomedical development is about 50 million per product. In terms of the introduction of outstanding talents, the government has issued a series of attractive policies such as "Foreign spouses and children of high-level Chinese talents can apply for permanent residence", encouraging top talents in the field of medicines and medical devices, overseas talents and teams to establish in Beijing enterprise.

7.2.3 R & D resources

Beijing has a relatively complete state-level talent reserve and multi-level talent system

construction. Zhongguancun College of Life Sciences has gathered more than 150 high-end talents and built a multi-level talent system including 20 academicians and 50 thousand. At the same time, Beijing has established a better integration model of production, teaching and research. It ranks first in the national biological disciplines, second in the number of authorized biological patents, the top two in the country in the number of MRCT trials, and the top 20 in biomedical patent conversion rate. The cooperation between universities, scientific research institutions and enterprises is fast and efficient, forms an effective connection of resources, and accelerates the rapid listing of new biomedical products.

7.2.4 Innovation system

Relying on the industrial carrier of "Zhongguancun District 1 and 16 Parks", Beijing's biomedical industry has formed clusters in Changping Park, Daxing Park, Yizhuang Park, Haidian Park and other parks. The industrial parks currently among the top 100 biomedical industrial parks in 2020 include Zhongguancun Science Park and Beijing Economic and Technological Development Zone. As my country’s first state-funded innovation demonstration zone, Zhongguancun promotes the innovative development of all enterprises in the park through a group of listed companies. Currently, Zhongguancun has gathered more than 4,000 biomedical companies, including mature foreign-funded companies and leading domestic pharmaceutical companies, as well as start-up biomedical companies. Through the linkage and cooperation of leading enterprises and high-tech small and medium-sized enterprises, Beijing creates a "big with small" cooperation model and innovation system. Through the rapid industry-university-research cooperation model, various types of innovation platforms such as the "public technology platform for industry-university-research cooperative institutions", "technological business incubators", and "technological enterprise accelerators" are established to give full play to the unique advantages of different institutions and enterprises to accelerate the rapid launch of new drugs .

7.2.5 Financing capacity

The amount and scale of Beijing Bio-medicine's financing are both at the leading level in the country, with its financing diversification and its financing channel perfection and convenience all ranking second in the country. At the same time, Beijing is also actively exploring the reform of the supply-side structure of technology finance, and constantly exploring innovative models of financial services.

7.2.6 Corporate capability

Beijing has a large number of listed bio-pharmaceutical companies and management talents. Among them, the C-level management talent background ranks third in the country. The aggregation of these companies has also become the core driving force for promoting innovation and development. Through the industrial clusters of different types of enterprises in the Zhongguancun 16 Park, leading enterprises drive downstream innovative enterprises and give full play to the driving force of market innovation.

7.3 Guangzhou

As the central city of the the Greater Bay Area of Guangdong, Hong Kong and Macao, Guangzhou has developed rapidly in the bio-pharmaceutical industry, driven by the innovative capabilities of the "two cities and one island" bio-pharmaceutical industry belt.

7.3.1 Infrastructure

Guangzhou has the advantages of a national biological industry base and a national pharmaceutical export base. Taking advantage of the opportunity of building a national independent innovation demonstration zone in the Pearl River Delta, it actively learns and borrows from Beijing's Zhongguancun experience to ensure complete welfare facilities. It has rich medical resources. The number of public tertiary hospitals exceeds 35, and the number of licensed doctors is 3.63/per thousand, which has exceeded the national level. The greening investment funds are complete, and the government has invested about 12 million in the construction of biological islands for municipal greening maintenance and landscape upgrades. To better optimize the environment, it builds high-standard supporting infrastructure. In addition, Guangzhou is also actively maintaining good interaction and cooperation with the Hong Kong Science and Technology Park, Shanghai and Beijing to continuously improve the construction of the biomedical industry.

7.3.2 Policy guarantee

The Guangzhou government's guidance fund is sufficient and the talent attraction bonus policy is attractive. The government not only provides policy rewards for successfully marketed drugs and devices, but also provides different funding support for new drug projects that start clinical phase I, II, and III research. The cumulative government rewards for bio-medicine development are about 132 million yuan per product. The scale of the guiding fund ranks fourth. In terms of talent introduction, the Guangzhou government provided 5 million yuan in resettlement subsidies and 5 million yuan in start-up subsidies, and provided soft services such as priority enrollment for children and settlement of themselves and their families.

7.3.3 R & D resources

Some indicators of the biomedical industry in Guangzhou rank among the top in the country. For example, the total score of biological disciplines ranks third in the country, the number of authorized biological patents ranks fifth, and the number of MRCT trials carried out ranks 12th in the country. At the same time, under the guidance of the municipal government, Guangzhou has established an innovation center and training academy, striving to transform to high-end R&D. With the help of enterprises and R&D institutions in the biological park as the main body, Guangzhou has built technology alliances and associations to promote the sharing of information resources and human resources, ensure the full utilization and flow of r&d resources, and further enhance the cooperation and mutual assistance influence between the biological island and enterprises in the development zone.

7.3.4 Innovation system

Guangzhou City currently has four biological companies with invention patents accounting for more than 80% of the total number of patents, reflecting the relatively excellent core innovation capabilities of the company. In order to better accelerate innovation, the government has built an international bio-industry cooperation and exchange base, maintained good interactive relations with the United Kingdom and Israel, and invested and guided leading companies such as Guangzhou Pharmaceutical and Guanhao Biology. Also, A china-Israel biotechnology investment fund of 606 million yuan will be set up in Guangzhou International Biological Island to invest in Israeli biotechnology projects registered in Guangzhou. It is estimated that by the end of 2020, 40 Sino-Israeli cooperation or Israeli investment projects will be introduced to learn from the successful experience of Israeli bio-medicine development.

7.3.5 Financing capacity

Guangzhou has established the characteristics of "targeted investment promotion" and initially established eight major service systems including commercial services, financial services, and property services. Among them, Guangzhou's financing diversification ranks 9th in the country, and the number and scale of biomedical financing ranks 5-7 in the country, with a good investment environment.

7.3.6 Corporate capability

Under the banner of "winning by quality", Guangzhou takes "making the enterprises in the park bigger and stronger" as its core goal to build a technological platform for superior enterprises. Among the top 500 companies in the pharmaceutical industry's main business income in 2018, Guangzhou was listed as 4 companies. Its C-level management talent background ranked 12th in the country.

7.4 Suzhou

Suzhou has advantages in the development of the bio-pharmaceutical industry: early layout of the industry, high enthusiasm, strong support, etc. Firstly, it built a leading industry innovation cluster, and then created a biomedical industry landmark, to create a "Strengthen two cores and expand multiple poles" regional layout. Also, its bio-medicine and medical equipment are in the forefront of the country. In the future, Suzhou will benchmark against Boston in the United States, build a unique "Chinese Medicine Valley", accelerate the introduction of industry flagship projects, continue to supplement, strengthen and expand the chain, and maintain an average annual growth rate of the biomedical industry at about 20%.

7.4.1 Infrastructure

Suzhou seizes the forefront of the pharmaceutical industry. The total production value of medical devices and chemical pharmaceuticals accounts for about 50% of the total Suzhou industry, with an average annual compound growth rate of as high as 18%. It maintains the attitude of “focus, unity, and innovation”, accommodates all types of corporate cornerstones with “the most complete industrial chain”, attracts talented craftsmen from multiple fields with “the strongest industrial cluster”, and gathers a strong industrial atmosphere with “optimal industrial ecology”. It perfectly integrates capital, talents and technological resources into an iron triangle

7.4.2 Policy guarantee

The Suzhou biomedical industry has experienced a period of initial exploration, rapid development and industry leadership, and a relatively complete top-level design of bio-medicine has been practiced during the exploration. In addition to policy support for clinical, listing, and registration, each company listed in capital will also be rewarded with a maximum of 1 million yuan. The cumulative government award for biomedical development is about 80 million yuan per product, which is More eye-catching in the same level of cities. In terms of talent policy, the government provides subsidies such as "one matter, one discussion", housing rental subsidies, green channels for professional title review, permanent residence, etc. The accumulated policy subsidies are about 20 million, which is very attractive. In addition, there is a breakthrough policy similar to “Excellent projects that use industrial Internet, big data, artificial intelligence and other technologies to carry out technological transformation of existing production facilities and process equipment, funded up to 15% of the project investment amount”, and government fund size ranks 11th.

7.4.3 R & D resources

Up to now, the Suzhou Biomedical Industrial Park has gathered 56 “national major talent introduction project” talents, 283 Gusu leading talents, 209 provincial talent for mass entrepreneurship and innovation, and nearly 50,000 innovative talents, ranking 12th among outstanding young talents in biology. At the same time, Suzhou has also established a number of biomedical alliances spontaneously formed by innovative entities. The total score of national biological disciplines is ranked 16th. The number of authorized biological patents is ranked 6th. The ecological environment of the biomedical industry is perfect.

7.4.4 Innovation system

At present, the Suzhou biomedical industry has covered raw materials, research and development, manufacturing, circulation, services and other links. It has a complete and innovative enterprise gradient cultivation system that can provide enterprises with full life cycle support. Specifically, Suzhou will screen out about 15 potential landmark companies each year for key cultivation, and set up a special service group for landmark enterprise cultivation to provide special services for enterprises. This series of measures enabled Suzhou to be successfully selected into the first batch of national strategic emerging industrial clusters, especially the Suzhou Industrial Park, which has ranked first in China's biomedical parks alongside Beijing Zhongguancun and Shanghai Zhangjiang.

7.4.5 Financing capacity

Currently, Suzhou ranks No. 3 in the country for diversified financing, No. 5 in the number of biomedical financing, and No. 7 in financing scale, and the investment environment is good. Now, Suzhou has 15 biomedical industrial parks, forming a strong agglomeration effect. On this basis, Suzhou will set up a Bio-medicine and medical health industry fund group with a total scale of more than 20 billion yuan to attract financial "running water" to water the growth of the enterprise.

7.4.6 Corporate capability

From 2015 to 2016, the Suzhou biomedical industry showed a growth trend. In 2016, there were 174 biomedical high-tech enterprises in the city, a year-on-year increase of 24.3%. Also, it realized a total industrial output value of 14.11 billion yuan, a year-on-year increase of 12.9%. Besides, it had more than 20,000 employees, a year-on-year increase of 15.4%. Among the top 500 companies in the pharmaceutical industry's main business income in 2018, there were five companies in Suzhou, and the C-level management talent background ranked top five in the country.

7.5 Hangzhou

The “one core, three parks and multiple sites” layout of Hangzhou's biomedical industry has been formed, including Qiantang New District, which aims to build a high-end biomedical product research and development area, Yuhang, which focuses on high-end medical equipment, and Binjiang, which focuses on smart medical care, Qiantang New District, which is committed to building a high-end production base and the biomedical characteristic bases distributed throughout the city. In terms of subdivisions, Hangzhou ranks high in the fields of bio-medicine, medical equipment and medical services. In the future development direction, Hangzhou will set out to plan to build a biomedical innovation city with the whole chain in line with ICH standards, and determine the three supporting systems and advancement paths of "new drug research and development, medical devices, and medical data".

7.5.1 Infrastructure

As one of the important development cities in the Yangtze River Delta, Hangzhou has convenient transportation and rich medical resources. There are more than 20 public tertiary hospitals, and the number of practicing doctors is 4.6 per thousand people. The hospital resources are at the middle and upper reaches of the country. Currently, Hangzhou has the highest net inflow of population in the country, with a net inflow of approximately 300,000 talents each year. At the same time, the Yangtze River Delta G60 Science and Technology Innovation Corridor Biomedical Industry Alliance was also established in Hangzhou Pharmaceutical Port. 55 companies in various fields such as bio-medicine, chemical medicine and medical equipment from Shanghai, Jiangsu, Zhejiang and Anhui jointly established an industrial alliance in Hangzhou Pharmaceutical Port, which formed the ecological integration system of bio-medicine innovation chain integration.

7.5.2 Policy guarantee

In order to accelerate the cultivation of the development of the biomedical industry, Hangzhou has issued a series of policy documents to promote the development of the biomedical industry, mainly including support for newly introduced various types of talent entrepreneurial projects, implementing a "recognition + review" system, and implementing the recognition and immediate reporting of projects registration. Also, the registration will be given a subsidy of up to 1 million yuan for start-up capital of 500,000 yuan for business start-up voucher of 200,000 yuan for site renting. "The 13th Five-Year Plan for the Development of Health Industry in Hangzhou" strengthened policy support. "Hangzhou city on deepening the up to once reform to build a first-class business environment implementation opinions" put forward 28 specific measures, guided by deepening the reform of "Run once at most", and continue to improve efficiency and provide better services by streamlining processes, reducing deadlines, and reducing costs. Also, Hangzhou works hard to remove institutional barriers that are not appropriate to energize enterprises, and create a world-class business environment. The accumulated government rewards for the development of bio-medicine are about 20 million yuan per product, and the scale of government entrepreneurship guidance funds ranks seventh.

7.5.3 R & D resources

First of all, on the basis of industry, Hangzhou has gathered about 22 tertiary hospitals and 20 drug clinical trial institutions, providing abundant clinical resources for the development of the biomedical industry. It is also an important innovation support carrier for drug research and development. Secondly, Hangzhou also has more than 100 leading domestic core enterprises and R&D institutions, including 16 colleges and universities specializing in bio-medicine such as Zhejiang University and West Lake University, ranking 7th in the national total score of biological disciplines. Zhejiang University has been built Innovative Medicine Research Institute and China Pharmaceutical University Innovation Research Institute. Besides, it cooperates with The Chinese Academy of Sciences Tsinghua University, China Pharmaceutical University, UCLA, Oakland University and other universities to build the innovation center. The number of authorized biological patents ranks 8th nationwide, and the number of MRCT trials carried out is 5th nationwide.

7.5.4 Innovation system

Hangzhou's biomedical innovation resources are increasingly concentrated, and top universities are gathering, forming a pattern of interaction between industry, university and

research. Hangzhou has not only gathered more than a thousand biomedical companies, but also more than 100 leading domestic core companies and R&D institutions, including Zhejiang University, West Lake University, Alibaba Cloud, Betta Pharmaceuticals, East China Pharmaceuticals, Tigermed, Dean Diagnostics , Nuoerkang, etc. It forms an integrated ecological system for the entire chain of biomedical innovation. Three factors — — Industry-university-research are highly concentrated in a very close area, forming the source of innovative research talents and the most convenient geographic environment for information communication and exchange. It also enables a large number of basic research created by the interaction of these three factors. The results have a fairly concentrated overall effect and can become a rich source of innovation and transformation.

7.5.5 Financing capacity

Hangzhou ranks 4th in the country in terms of the amount of biomedical financing and the diversification of financing. Its investment environment is good. Hangzhou initiated and set up a ten-billion-yuan dual-currency fund for the biomedical industry, focusing on investing in domestic and foreign biomedical enterprises, helping the invested products to effectively enter the global market, and actively introducing venture capital companies and teams mainly in the biomedical field to provide financial support for innovative bio-medicine.

7.5.6 Corporate capability

From Nuoerkang’s production of China’s first cochlear implant that broke internationally similar products, to the first non-profit bio-pharmaceutical company listed on the Hong Kong Stock Exchange after the launch of the new system, to a WeDoctor platform with 160 million real-name mobile phone users, Hangzhou has initially formed multiple sub-industry clusters and a large number of industry champions such as new chemical drugs, modern Chinese medicines, and biotechnology pharmaceuticals after 20 years. Among the top 500 companies in the pharmaceutical industry's main business income in 2018, Hangzhou was listed as 13 companies, and the C-level management talent background ranked seventh in the country.

7.6 Shenzhen

The bio-pharmaceutical industry has formed a "three core areas with some other areas" industrial spatial layout structure in Shenzhen, with a strong industrial foundation and abundant spatial resources. Among them, Shenzhen ranks among the best in the field of medical devices. However, Shenzhen's R&D resources are insufficient, with leading companies accounting for less than 10%, and development needs to be done. Therefore, in the future, Shenzhen will focus on introducing large foreign bio-pharmaceutical companies or cultivating the development of innovative companies in the city on the premise of maintaining the development of the bio-pharmaceutical industry, so as to accelerate the development of leading companies, increase R&D resources, and strive for 25 years of bio-medicine. The total industrial output value reached 200 billion yuan.

7.6.1 Infrastructure

As one of the four central cities and the core engine in the Greater Bay Area of Guangdong, Hong Kong and Macao, Shenzhen ranks among the top in the country in the number of high-tech conventions and exhibitions. It has about 7 public tertiary hospitals and the number of practicing doctors is 2.7 per thousand people. In terms of output value, the total output value of Shenzhen's pharmaceutical manufacturing industry is in the first echelon in the Greater Bay Area

of Guangdong, Hong Kong and Macao, with rapid development and a growth rate of 10%. But in terms of added value, the added value of Shenzhen's biomedical industry is relatively small. The added value of Shenzhen's biomedical industry in 2019 was 33.781 billion yuan, ranking last among the seven strategic emerging industries, accounting for only 3.3%, and it needs to develop in the future.

7.6.2 Policy guarantee

Shenzhen has formulated a series of policies to support the development of the biomedical industry in detail. In addition to the "pharmaceutical and device marketing incentives", "clinical trial development incentives" and "talent introduction and attraction policies" that other cities have, Shenzhen also provides breakthrough policies, such as actively encouraging relevant insurance institutions to provide biological medical liability insurance of human clinical trials biological medicinal products, customized comprehensive insurance products liability insurance and so on. For qualified biomedical institutions and enterprises, 50% of their actual premium payment shall be subsidized, with a single policy not exceeding 500,000 yuan at most and a single enterprise not exceeding 5 million yuan at most annually. The scale of government entrepreneurship guidance fund ranks the third. At the same time, Shenzhen is on par with Guangzhou in encouraging innovation. Focusing on "strengthening independent innovation capabilities", "vigorously promoting high-end industrial development", "building an industrial support service system", and "creating a good industrial innovation environment", a sound top-level design has been constructed.

7.6.3 R & D resources

Although Shenzhen's drug production capacity is at the forefront of the country and has certain research and development capabilities, the research and development resources for new drugs are weak. As of 2018, there are only five medical institutions in Shenzhen that have the qualifications for drug clinical trials: Shenzhen Traditional Chinese Medicine Hospital, Shenzhen Donghu Hospital, Shenzhen Second People's Hospital, Peking University Shenzhen Hospital, and Shenzhen People's Hospital, accounting for 0.6% of 822 hospitals in the country. Its national total score of biological subjects ranks 30, which does not match the position of the third largest city in China in terms of economic aggregate.

7.6.4 Innovation system

The bio-pharmaceutical industry has formed a "three cores and multiple points" industrial spatial layout structure in Shenzhen. Pingshan District, one of the cores of Shenzhen bio-medicine, has the first batch of national biological industry bases in the country. Since the establishment of the administrative region in 2017, the biomedical industry development trend is strong, gathering 430 bio-pharmaceutical companies, more than 10 scientific research institutes and industrial service platforms. Nearly 10 bio-entrepreneurial service organizations are growing at an annual rate of 40% and output value at an average annual rate of 30%, with more than 100 settlements each year. The overseas team or project has formed a relatively complete industrial chain. Shenzhen has also actively promoted the agglomeration of high-end innovation resources. It has successively introduced major innovation platforms such as Monash Technology Transformation Research Institute, Shenzhen Bay Laboratory Pingshan Bio-medicine R&D and Transformation Center, and Guangdong Medical Device Quality Supervision and Inspection Institute to accelerate the realization of "medical-industry integration".

7.6.5 Financing capacity

Shenzhen ranks 2nd in bio-pharmaceuticals financing scale, 3rd in financing volume, 5th in financing diversification, and it has an excellent investment environment. In 2018, the first batch of Shenzhen high-tech industrial parks (supported by science and technology resources) totaled about 25 million yuan, which was used for the allocation of special funds for the development of small and medium enterprises to better support the survival of small and micro enterprises.

7.6.6 Corporate capability

In terms of the number of companies, Shenzhen has the largest number of biomedical companies in the country. Shenzhen's biomedical industry has experienced explosive growth in recent years, with a total of more than 1,000 enterprises, making it the city with the largest number of biomedical companies in the country. In addition, Shenzhen has a number of listed bio-pharmaceutical representative companies, which have become the backbone of the development of Shenzhen's bio-pharmaceutical industry. However, although Shenzhen has thousands of biomedical companies, its leading companies account for less than 10%, and about 40% of them have been established in less than two years.

7.7 Tianjing

Tianjin's biomedical industry has initially formed a pattern of industrial clusters with Binhai New Area as the core area and regional characteristics such as Wuqing, Beichen, and Xiqing. Bio-medicine, medical equipment and medical services rank upstream. In the future, Tianjin will take advantage of the favorable policies and focus on the production side of large healthy enterprises, break through the development of the biomedical industry, and make efforts in the approval process, policy implementation process, and cold chain transportation process to support the development of enterprises.

7.7.1 Infrastructure

Tianjin has a wealth of medical resources, gathering more than 25 public tertiary hospitals. The number of practicing doctors is 2.8 per thousand people. In order to promote the coordinated development of Beijing-Tianjin-Hebei medical security and deepen the cooperation in the medical field of the three places, Tianjin once again expanded the scope of the pilot direct settlement of outpatient clinics. At present, 62 medical institutions have achieved direct settlement of outpatient clinics of the three places.

7.7.2 Policy guarantee

In August 2019, the Tianjin Municipal Supervisory Committee issued the "Several Opinions on Further Supporting the High-Quality Development of the Biomedical Industry in Our City", and introduced 10 policies to support the high-quality development of the biomedical industry. In addition, the Tianjin Municipal Government has also strengthened communication with the State Administration for Market Regulation and the Drug Evaluation Center to establish a green channel for drug review and improve the efficiency of drug review and approval in the city. Innovative drugs, drugs that have passed quality consistency evaluations, specific drugs, orphan drugs, and children's drugs are supported in terms of procurement and funding. Tianjin study and formulate relevant policies for the trial of the drug marketing license holder system, and establish and improve the expert demonstration system for the examination and approval of innovative drugs. Also, it carries out intellectual property training in the biomedical industry, and improve the ability of enterprises to make full use of internationally accepted intellectual property rules and deal with intellectual property issues. The scale of government entrepreneurship guidance

fund ranks the 8th.

7.7.3 R & D resources

Tianjin has well-known domestic comprehensive universities such as Nankai University and Tianjin University, as well as two professional undergraduate colleges, Tianjin Medical University and Tianjin University of Traditional Chinese Medicine. In addition, the Tianjin biomedical field has 2 engineering technology research centers, 4 key laboratories, 1 clinical medicine research center, 6 enterprise technology centers, and 15 ministerial-level key laboratories. A group of high-level R&D platforms, including Tianjin Institute of Medicine, Tianjin International Institute of Bio-medicine, Tianjin Institute of Industrial Biotechnology and Tianjin Institute of Industrial Biotechnology, have been gathered together, preliminarily forming a complete innovative R&D system. At the same time, in terms of talent introduction, Tianjin makes full use of the "Haihe Talents" action plan to increase the introduction of high-level innovative talents in the biomedical field local or abroad, actively develop talent training cooperation with domestic and foreign medical schools, and broaden talent introduction channels. Besides, it increases the financial investment in the city's medical vocational colleges and builds Tianjin into a training base for high-skilled medical personnel in my country.

7.7.4 Innovation system

Tianjin has formed a joint development pattern of many biomedical industry incubators, such as the Binhai New Area Biomedical Industrial Park with Binhai New Area as the main body, the Western Biomedical Industrial Park of Tianjin Economic and Technological Development Zone, and the National Biomedical International Innovation Park. It has a certain basis and conditions in biological medicine manufacturing and other fields. At present, a complete industrial chain integrating chemical medicine, traditional Chinese medicine and bio-pharmaceuticals has been formed. Also, eight projects are put into practice, including the transformation and upgrading of chemical medicines, the modernization and internationalization of Chinese medicines, the development and transformation of bio-pharmaceuticals, and the cultivation of medical devices , Health industry deepening, public service platform construction, bio-medicine quality brand promotion and industrial integration development.

7.7.5 Financing capacity

Tianjin coordinates the use of special funds related to intelligent manufacturing, development of technological enterprises, and development of small and medium-sized enterprises. It established a 20 billion Tianjin Zhongke Haihe Biomedical Industry Fund to invest in foreign investment through direct investment projects or sub-funds, mainly investing in biomedical technology companies in Tianjin related to the biomedical industry, and set up the Industrial Biology Institute and the internal and external systems of the Chinese Academy of Sciences platform company for the transformation and cultivation of scientific and technological achievements, jointly promote the industrialization of high-quality projects in the 130-mu scientific and technological innovation base and 3000-mu industrial base of the Industrial Biology Institute. With the support of this industry fund, Tianjin will play the role of a 30 billion yuan biomedical industry fund to drive social capital to carry out equity investment, support bio-pharmaceutical companies to expand financing channels and develop technology financial services such as intellectual property pledge financing and technology guarantees.

7.7.6 Corporate capability

Tianjin intends to build this city into an important national innovation base for the

bio-pharmaceutical industry and a bio-pharmaceutical R&D and transformation base with global influence. At present, there are 90 pharmaceutical manufacturing companies in Tianjin, 14 of the top 500 pharmaceutical industry companies, 4 of the top 100 pharmaceutical industry companies, and 24 listed companies, including Tianjin Pharmaceutical Group, Tasly, Zhongxin Pharmaceutical, Hongri Pharmaceutical and Kellerin. A group of leading companies, such as Hankang Pharmaceutical, Sino Medical, Tianyan Medical Education, and Kangsino Biology, have become the backbone of Tianjin's bio-medicine field, forming an advantage in the field of chemical medicine and traditional Chinese medicine. By 2020, the city's biomedical industry will reach 150 billion yuan. Among them, the main business income of the manufacturing industry reached about 80 billion yuan, the city's drug logistics and distribution capacity reached about 60 billion yuan, and the R&D service income reached about 10 billion yuan. The industrial added value strives to maintain double-digit growth, and the R&D expenditures of biomedical companies above designated size account for more than 3.5% of the main business income.

7.8 Nanjing

Nanjing has formed a bio-medicine "one valley, one town, three parks" industrial cluster area, namely Nanjing Biomedical Valley (Jiangbei New District), Nanjing Life Science and Technology Town (Jiangning District), Jiangsu Life Science and Technology Innovation Park (Qixia District), Gaochun Medical Health Industrial Park, Nanjing API Industrial Park (Jiangbei New District). It has the country's leading biomedical innovation capabilities and rich innovative talents. Bio-medicine and medical services ranked in the forefront and medical equipment ranked above mid-table. However, the total industrial scale is small, capital activity is not high, without forming the industrial layout of dislocation development. Therefore, in the future development direction, Nanjing will make precise breakthroughs in small cuts, use hard technology to promote high-quality development, gather innovative resources, and accumulate industrial innovation power.

7.8.1 Infrastructure

Nanjing is located in the east of China, the lower reaches of the Yangtze River, and the coastal waters. It is an important gateway city for the development of the central and western regions in the Yangtze River Delta as planned by the State Council. It is also an important node city where the eastern coastal economic belt and the Yangtze River Economic Belt strategically converge. In recent years, there have been a large number of high-tech exhibitions. It has about 28 public tertiary hospitals, and the number of practicing doctors is 2.4 per thousand people. The number of doctors has increased steadily, ranking 22nd in the country and 12th in the growth of the pharmaceutical market. Taking into account the steady growth and development of Nanjing's infrastructure construction, its core focus is aiming at biology and creating a 100 billion-level industrial landmark.

7.8.2 Policy guarantee

Nanjing has a good entrepreneurial guidance fund. The government entrepreneurship guidance fund ranks 5th. To better absorb the head enterprise, Nanjing has invested in the establishment of regional headquarters, R&D centers or industrial bases in the new area for Fortune Global 500 companies, Chinese biomedical companies, well-known biomedical multinational companies, or China's top 100 pharmaceutical companies, with a registered capital of $20 million or 200 million yuan. The reward is based on 2-5% of the actually paid registered

capital (referring to the paid-in capital), and the maximum for a single enterprise does not exceed 100 million yuan. In the course of business development, the annual income reaches 1 billion yuan for the first time, and another 2 million yuan one-off reward will be given. At the same time, Nanjing has also promulgated a number of policies to promote more innovative elements and the agglomeration of industrial resources, such as the "Implementation Plan for Deepening the Reform of the Medical and Health System in Nanjing (2019-2020)" and "Several Policies for Development of Jiangning District in Nanjing to Accelerate the Promotion of High-quality Bio-medicine Industry ". Nanjing strives to develop 10 new drugs of Class 1 and 10 medical devices of Class 3 independently developed by 2022, attract 500 high-level talents at district level or above, and 20 listed companies, with an output value exceeding 50 billion yuan.

7.8.3 R & D resources

Nanjing is one of the cities with the largest number of biomedical education colleges in the country. There are 20 colleges and universities engaged in Bio-medicine and life science teaching such as China Pharmaceutical University, Nanjing University of Traditional Chinese Medicine, Nanjing University, etc., ranking 4th in the national biological subject score. The advantages of Bio-medicine talents are leading in the country. There are more than 20,000 doctors, masters and undergraduates majoring in Bio-medicine graduate each year. Nanjing is rich in R&D resources, with key laboratories and engineering technology centers ranking in the forefront of the country. There are more than 2,300 medical and health institutions of various types, 28 tertiary hospitals, and health institutions with more than 50,000 beds. There are abundant national and provincial talents. The number of authorized biological patents is 4th, and the number of CROs and SMOs is 5th.

7.8.4 Innovation system

The scale of Nanjing's Bio-medicine industry reached 60 billion yuan. The total income of the biomedical industry park was 5,739.94 billion yuan, and 9 R&D companies were incubated. In 2018, Nanjing had 8 national first-class new drug certificates, 310 clinical acceptance of new drugs of category 1 and 2, ranking fifth in the country. The total number of drug clinical trials was 1,149, ranking fifth in the country. The number of domestic patents authorized for Bio-medicine was 2005, ranking eighth in the country. The number of listed medical device projects in categories 2 and 3 ranked eighth in the country. 8 medical device products entered the national innovation special approval procedure. 10 domestic new drugs entered the national priority review list; The number of platforms' public services for the biomedical industry ranks third in the country. There are 8 national-level biomedical innovation carriers including the National Health and Medical Big Data (Nanjing) Center and the National Genetic Engineering Mouse Resource Bank. Also, there are more than 60 provincial and ministerial-level innovation carriers. In terms of the number of enterprises, there are currently 69 pharmaceutical industrial enterprises, 26 medical device industrial enterprises, more than 800 biomedical research and development enterprises, more than 100 pharmaceutical wholesalers, and 2 national pharmaceutical industry top 100 enterprises, sales. Besides, there are 8 enterprises exceeding 1 billion yuan. In terms of talents, Nanjing ranks third in the country for innovative talents, and the number of basic talents exported ranks first in the country.

7.8.5 Financing capacity

Nanjing's overall capital management system and financial service level are at the forefront, with stable development and excellent environment, and a certain scale of biomedical enterprise

funds has been formed. The number of Bio-medicine financing ranked 8th, and the diversification of financing ranked 13th. The number of exits from IPOs accounted for 81% of the total number of investment exits.

7.8.6 Corporate capability

Nanjing focused on upgrading the business environment and continued to improve its management and service mechanism. It focused its efforts on cultivating competitive industries, continued to grow industrial clusters, and formed an ecosystem integrating innovation and industrial, and the overall industry showed “explosive” growth. Among the top 500 companies in the pharmaceutical industry's main business income in 2018, Nanjing ranked 6 on the list. Pharmaceutical Valley has gathered a number of leading innovative companies such as Simcere TECO, Luye Pharmaceutical, Jianyou Biochemical, Pharmaceutical Stone Technology, Nanwei Medical, World and Gene. At present, most of the top 20 companies in the domestic gene sequencing industry have settled in Biomedical Valley Park.

7.9 Chengdu

As one of the central cities in the Chengdu-Chongqing urban agglomeration, Chengdu has built a modern industrial system dominated by Bio-medicine with its characteristic development path of "three medical integration". The development of its biomedical industry has played a demonstrative role for the entire southwestern region. Among them, Chengdu's Bio-medicine and medical services are among the top, and medical devices are also the top. In the future, Chengdu will guide the "two cities" to achieve differentiated and complementary development, increase support for local leading companies and foster potential companies, increase recruitment, and innovate government service methods.

7.9.1 Infrastructure

As an important Bio-medicine gateway in Southwest China, Chengdu is not only an important R&D innovation and industry incubation center built by Sichuan Province, but also an important domestic platform for industry-university-research integration. What’s more, it is an important base for international pharmaceutical and western R&D cooperation. The per capita expenditure on biomedical insurance is about 2,200 yuan. As of the end of 2019, Chengdu had 48 Grade-A hospitals. The number of practicing physicians is 3.8 per thousand people.

7.9.2 Policy guarantee

Policy in Chengdu the top-level design perfect, top-level design also mention many hot areas, such as to seize the vaccine industry restructuring integration opportunities, support ascension in rong vaccine enterprise production scale and development level, speed up the construction of a world-class blood products industry base and international antibody drug industry transfer bearing base, create global biotechnology drug production center. At the same time, Chengdu successively launched the "Implementation Opinions on Promoting the High-Quality Development of Chengdu's Pharmaceutical and Health Industry" and "Several Policies to Promote the High-quality Development of Chengdu's Biomedical Industry", striving to build a world-class medical and health industry highland, and supporting translation in multiple dimensions from all aspects, spending money on supporting the full life cycle. The scale of government entrepreneurship guidance fund ranked 9th.

7.9.3 R & D resources

Chengdu's R&D resources are acceptable. It has rich university scientific research resources

such as Sichuan University, Chengdu Institute of Biology of the Chinese Academy of Sciences, University of Electronic Science and Technology of China, etc., continuously delivering fresh blood for technological iteration and innovation, and ranking 6th in the national total score of biological disciplines. Take Chengdu Tianfu Life Science Park as an example. There are more than 6,000 Bio-medicine employees in the park, including 1 Nobel Prize winner, 17 national-level Thousand Talents Program, and 38 Sichuan Thousand Talents Program. The number of authorized biological patents ranked 7th, the number of MRCT trials carried out ranked top 10 in the country, and the number of clinical service employees ranked 11th.

7.9.4 Innovation system

Chengdu's internal industry-university-research construction system ranks high in the country. Chengdu Frontier Medical Center undertakes the transformation needs of all medical and pharmacy projects in Sichuan University. At the same time, relying on the rich Bio-medicine research and development resources in the provinces and cities and the innovation incubation system of the high-tech zone, the park has gathered a large number of well-known domestic and foreign companies and institutions, as well as innovative and entrepreneurial enterprises funded in the fields of antibody drugs and protein drugs, major disease diagnosis and detection technology, gene therapy and cell management and other bio-therapeutic technologies, innovative generic drugs, traditional Chinese medicine and natural medicine, CRO and medical devices. Moreover, Chengdu gives full play to the advantages of information institutions to provide comprehensive and multi-level scientific and technological information services to enhance the core competitiveness of the park. In addition, Chengdu Tianfu Life Science Park has joined hands with well-known parks in the Pan-Yangtze River Basin, including Shanghai Zhangjiang Park and Suzhou BioBay, to launch the Yangtze River Basin Biomedical Innovation Service Alliance, aiming to promote the coordinated development of parks in different locations.

7.9.5 Financing capacity

Chengdu has good financing diversification capabilities, and actively leverages the guiding role of government funds. Relying on the high-tech financial service platform of the high-tech investment group, it realizes the accumulation of angel investment, venture capital, venture capital, PE fund investment, financing guarantee and other capital resources. In addition, the market mechanism was used to leverage more than 1 billion social capital with 100 million government funds. The diversification of financing ranks 6th in the country, and the number of biomedical funds ranks 19th in the country. The overall number of exits from IPO accounts for 78.95% of the total number of investment exits.

7.9.6 Corporate capability

In recent years, the investment and profit of Chengdu's biomedical industry have increased by more than 20% annually, and the profit rate is 2.9 times the average profit rate of the city's industry. Among the top 500 companies in the pharmaceutical industry's main business income in 2018, Chengdu ranked 23 on the list. In 2019, the city's regulated bio-pharmaceutical companies achieved operating income of 68.6 billion yuan, completed an investment of 17.95 billion yuan in the pharmaceutical industry, and were included in the first batch of national biomedical strategic emerging industrial clusters.

7.10 Wuhan

In accordance with the layout of "one city, one park and three centers", Wuhan has built a

number of high-end industrial parks with distinctive characteristics, clear positioning, complete supporting facilities, and green ecology. The successful experience has been extended to 8 prefecture-level cities in Hubei Province, forming Hubei mode. From the perspective of subdivisions, Wuhan's medical equipment ranks in the forefront, and Bio-medicine and pharmaceutical research and development ranks in the upper middle. Therefore, in the future development and construction, Wuhan will build a professional park to further guide the differentiated and agglomerated development of enterprises, lay out emerging industries, enhance sustainable development capabilities, and build a new echelon development pattern of "nuclear-polar-park-circle" big health industry.

7.10.1 Infrastructure

Wuhan is rich in medical resources. As of the end of 2018, there were 61 tertiary hospitals in Wuhan, the number of tertiary hospitals accounting for 38.57% in Hubei Province, and the number of practicing physicians was 3.4 per thousand. At the same time, Wuhan has also built a green channel for administrative services, integrated the provincial municipal affairs resources, and handled tasks such as new drug inspection, testing and declaration on the spot, forming a service system with one-stop approval, zero-distance testing, and full coverage of third-party services.

7.10.2 Policy guarantee

Wuhan has issued a number of policies that are in line with national policies and encouraged existing enterprises, such as “encourage the city’s pharmaceutical and medical device manufacturers to use the MAH system and provide subsidies”, “For the city’s newly built national pharmaceutical logistics parks and distribution centers, subsidies will be 10% of the actual investment, and the subsidy for a single project will not exceed 5 million yuan", and the "3551 Optics Valley Talent Plan" Interim Measures (2018 Edition) of Wuhan East Lake New Technology Development Zone will be issued to better recruit troops. At the same time, Optics Valley adheres to the combination of top-level design and operability, and has built a "1+5+6" comprehensive reform and innovation framework system. "1" refers to the "Overall Action Plan for Building a Globally Influential Innovation and Entrepreneurship Center"; "5" refers to the Free Innovation Zone, "Fit link All Things", Smart Optics Valley, Ecological and Livable Optics Valley New City, and "Internet +" five specific implementation plans; “6” refers to the policy systems of innovation and entrepreneurship, industrial development, technology finance, intellectual property, talent support, and open cooperation.

7.10.3 R & D resources

Wuhan has excellent R&D resources, ranking 5th in the national biological disciplines, 8th in the number of clinical service employees, and 14th in the number of biological patents granted. At present, Wuhan has successfully established a talent attraction mechanism. As of 2018, Optics Valley Bio-City has 4 Nobel Prize winners, 27 academicians, 28 national "Thousand Talents Program", 70 "Hundred Talents Program in Hubei Province", 19 "Wuhan City Partners", 42 “thousands companies link with people in Wuhan province” and 537 high-level biological talent teams local and abroad.

7.10.4 Innovation system

Based on the MAH system as a pilot, in accordance with the idea of “gathering a group of active and innovative start-ups, accurately cultivating a group of potential medium-sized enterprises, and focusing on supporting a group of industry-leading leading enterprises”, Wuhan

conducts “teaching in accordance with their aptitudes” "Precise support", "targeted cultivation" for enterprises at different stages, promotes the gathering of innovative subjects, and establishes 33 public technical service platforms including genome sequencing analysis platform and 11 incubation acceleration platforms such as the incubation period of Optics Valley new drugs. Among them, Optics Valley is aiming at the commanding heights of the biological industry, seizing the fields of genetic engineering drugs, cell therapy, genetic testing, digital medical imaging, and smart medical care, and actively exploring innovation and development. In 2016, the total revenue of Optics Valley bio-pharmaceutical enterprises exceeded the 100 billion yuan, It was the second biomedical industrial park in the country with an output value of over 100 billion. In 2018, Optics Valley Bio-city gathered more than 2,000 enterprises, with an annual industrial income of 120 billion yuan.

7.10.5 Financing capacity

At present, Wuhan's financing may be relatively weak and the investment environment is average. According to the statistics of Artery Network, there were only 17 medical and health investment and financing incidents in Hubei Province in 2018, with a value of only 520 million yuan. The number of biomedical funds ranks 13 nationwide, and the diversification of financing ranks 19th nationwide. But in the future, Wuhan will focus on financial resources, vigorously introduce financial service institutions, build a docking platform between enterprises and technical institutions, and establish a multi-level capital market with "venture investment as the leading and angel investment as supplement" and a financial system supported by technology credit.

7.10.6 Corporate capability

According to data, by the end of 17 years, Optics Valley had 149 enterprises with regulated industries, limited service industries, and limited commerce, among which 51 enterprises had revenues of more than 100 million yuan. Among the top 500 companies in the pharmaceutical industry in terms of main business income in 2018, Wuhan is on the list of nine. Currently, eight of the 13 bio-pharmaceutical companies ranked in the world's top 500 have settled in Optics Valley Bio-City. Over the past 30 years, Optics Valley has grown from "a street" to "a city", from a beam of light to an "131" industrial pattern, from a seed of entrepreneurship to a gathering of 30,000 companies, and thousands of individuals with wealth and more than tens of millions or over 100 million entrepreneurs have been born.

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