Patent Analysis and Development Strategy Recommendations for Foshan' s Biomedical Industry.doc

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Abstract

Due to its enormous economic and social benefits, the biopharmaceutical industry has become a sunrise industry in many countries. For the industrial development of Foshan City, the biopharmaceutical sector, given its broad development prospects, will be a key direction for future efforts. This paper conducts retrieval and analysis of patents in biopharmaceutical-related technology fields in Foshan City, examines the current research status from the perspective of patent literature studies, maps out the technological landscape, understands the main application directions as well as the strengths and weaknesses of relevant technology R&D, compares Foshan' s own technological characteristics, and formulates implementation proposals for patent portfolio planning. These include specific recommendations on: enhancing awareness of patent protection, management, and utilization; optimizing industrial structure and layout while grasping different development models across industries; improving the competitiveness of existing technologies; establishing risk early-warning mechanisms and delivering patent information services; and optimizing the development environment.

Full Text

Preamble

Suggestions on Development Strategy of Biomedical Industry in Foshan Based on Patent Analysis

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Abstract: The biomedical industry has become a sunrise industry in many countries due to its enormous economic and social benefits. For Foshan' s industrial development, the biomedical sector represents a key direction for future growth given its broad prospects. This paper analyzes patents related to biomedical technologies in Foshan, examining the current research landscape, mapping technology layouts, identifying primary application directions for R&D, and assessing strengths and weaknesses from the perspective of patent literature research. By comparing these findings with Foshan' s own technological characteristics, this study proposes implementation plans for patent portfolio development, including specific recommendations for enhancing patent protection, management, and utilization awareness; optimizing industrial structure and layout while adopting differentiated development approaches for various subsectors; improving the competitiveness of existing technologies; establishing risk early-warning mechanisms and delivering patent information services; and optimizing the development environment.

Keywords: biomedical industry; industry analysis; patent analysis; Foshan City

1 Overview of Foshan' s Biomedical Industry

Foshan is located in the hinterland of the Pearl River Delta, one of China' s most economically dynamic regions. Together with Guangzhou, it forms the "Guangzhou-Foshan Metropolitan Circle" and serves as a vital component of the "Guangzhou-Foshan-Zhaoqing Economic Circle" and the "Pearl River-Xijiang River Economic Belt," positioning it at the forefront of Guangdong' s economic and social development. The city governs five districts—Chancheng, Nanhai, Shunde, Gaoming, and Sanshui—covering a total area of 3,797.72 square kilometers with a permanent population of 7.3506 million, including 3.8561 million registered residents [1].

Foshan' s biomedical industry foundation remains relatively weak, with its current output value maintained at approximately 10 billion yuan. The industrial structure is still concentrated in low-end segments such as manufacturing, production, and distribution, revealing significant structural shortcomings in the industrial chain. However, with accelerated industrial transformation and heightened national emphasis on biomedicine in recent years, Nanhai District has prioritized biomedicine as a strategic emerging industry for cultivation, enabling the sector to demonstrate robust and rapid growth momentum within Foshan' s industrial landscape.

Presently, Foshan hosts two major biomedical industrial parks. The first is the South China Sea Biomedical Technology Industry Center of the Chinese Academy of Sciences [2]. In late 2009, the Nanhai District government and Dali Town launched a 100 million yuan special fund to collaborate with the Chinese Academy of Sciences in constructing this park in western Dali, which had been

incorporated into the industrial think-tank plate of Nanhai's central manufacturing base, aiming to cultivate industrial clusters. The second is the Guangdong Innovation and Transformation Biomedical Industry Park, located in Foshan New City, south of the First Ring Road and west of Xingui Road in Lecong Town, covering approximately 1,000 mu of land designated primarily for research, industrial use, and supporting commercial office space. According to its planning blueprint, the park is positioned as an international bio-industry center and an international bio-finance industry trading center. Its functional layout comprises four major platforms: a bio-industry incubation platform, an innovation and transformation bio-industry platform, a major (biological/medical) equipment industry platform, and an innovative bio-finance industry trading platform. The park will focus on two principal directions: R&D and industrialization of important biomedical drugs, and development and manufacturing of clinical testing equipment and major biological equipment. By continuously integrating technology, talent, and financial resources in relevant fields, it aims to build a national bio-industry "transformation-creation-trading" center that integrates "innovative bio-industry, big data diagnostic technology, major equipment industry, and bio-finance industry trading" [3].

In 2016, Foshan' s municipal-level science and technology resources were prioritized toward four major themes, with application guidelines focusing on the "Internet+" action plan, patent strategy, scientific and technological innovation platforms, and introduction of scientific and technological innovation teams. Municipal resources were specifically allocated to new materials and biomedical technology services as key industries and sectors for development, actively attracting scientific and technological innovation and entrepreneurship teams [4].

In July 2012, Nanhai District issued the "Notice on Issuing the Measures for Supporting and Rewarding the Development of Biomedical Industry in Nanhai District, Foshan City" to accelerate the cultivation and development of the biomedical industry, promote the construction of a southern China biomedical city, facilitate biomedical industry agglomeration, and enhance regional independent innovation capacity and industrial competitiveness. The key encouraged bio-industry categories include biopharmaceuticals, chemical drugs, modern traditional Chinese medicine, medical devices, health products, and biomedicine [5].

In Chancheng District, traditional Chinese medicine has been comprehensively applied in public health management for citizens. The district is now implementing the "Famous Specialty" and "Famous Physician" projects [6]. In February 2016, to encourage and support the development of the life and health industry within the district, the "Implementation Rules for the Measures to Promote the Development of Life and Health Industry in Chancheng District, Foshan City (Draft)" (hereinafter referred to as the "Implementation Rules") was released for public comment. Eight categories of life and health industries, including biomedical R&D and outsourcing services, will receive financial support, rent subsidies,

financing support, and other preferential policies. According to the Implementation Rules, the eight categories eligible for support include: biomedical R&D and outsourcing services, biotechnology and biomedical industry technology service platforms, bioinformatics, health services, medical devices, modern traditional Chinese medicine, biopharmaceuticals, and other biomedical industry projects recognized as having high technological content and good growth potential [7]. Several major projects have already entered the incubation and practice stage. For instance, Foshan Tibeike Biotechnology Co., Ltd. focuses on tuberculosis infectious disease research and produces tuberculosis diagnostic reagents, with two tuberculosis diagnostic kits and two drug-resistance testing kits under regulatory review, and two instruments entering the market. Researcher Li Yan from the Institute of Biophysics, Chinese Academy of Sciences, is establishing an independent third-party high-end biomedical testing laboratory. Associate Researcher Ren Ruotong from the same institute is working on the "Drug Screening and Evaluation Platform Based on Human Pluripotent Stem Cell Gene Targeting Technology" project, which aims to create a novel human disease screening and evaluation platform in the stem cell field.

Given biomedicine' s broad development prospects as a key future direction for Foshan, this paper conducts a retrieval and analysis of patents in Foshan' s biomedical-related technology fields. From the perspective of patent literature research, it analyzes the current research status, maps technology layouts, identifies primary application directions for related technology R&D and their advantages and disadvantages, compares these with Foshan' s own technological characteristics, and formulates patent portfolio implementation plans. Combined with the actual situation of Foshan' s biomedical patents, it proposes technological development strategies and patent risk prevention recommendations.

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2 Patent Analysis of Foshan' s Biomedical Industry

The patent data for this paper was retrieved on March 15, 2016, using the Innography database. The search strategy included IPC classification numbers related to the biomedical field and relevant thematic keywords.

2.1 Overall Patent Application Trends

A total of 1,630 patent applications were retrieved in Foshan' s biomedical field, including 767 granted patents, representing a grant rate of 47.1%. Currently, 516 patents remain valid, while 635 are under examination. Valid granted patents account for 31.7% of total applications, while patents under examination represent 40% of the total (detailed statistics are shown in Table 1).

The analysis reveals that Foshan' s patent application volume in biomedical technology is relatively modest. The pharmaceutical R&D cycle is lengthy, and since Foshan's pharmaceutical patent applications began relatively recently, this

has resulted in a limited current application volume. However, it is noteworthy that Foshan' s biomedical patent grant rate is relatively high, with a substantial proportion of applications under examination. The grant volume for the past three years has shown significant improvement.

Table 1 Overall Status of Foshan' s Biomedical Patents

Statistical analysis of Foshan' s patent application trends (Figure 1 [Figure 1: see original paper]) demonstrates that Foshan' s biomedical patent applications have shown rapid overall growth. A detailed analysis of this trend reveals several key phases:

Foshan filed its first biomedical patent in 1996, with minimal application volumes before 2003. Following China' s WTO accession, 2003 marked the first year Foshan' s biomedical patent applications exceeded 10 cases.

In 2005, Actavis invested $810 million to acquire the global generic drug business of U.S.-based Alpharma, replacing Foshan Alpharma and officially entering the Chinese market with production facilities in Foshan. The establishment of Actavis, the world' s third-largest generic drug manufacturer, in Foshan stimulated local biomedical patent applications to some extent. More importantly, in 2005, Foshan' s Economic and Trade Bureau repeatedly proposed revitalizing "Foshan Medicine." The "Implementation Plan for Building a National-Level Medical and Health Products Industry Base" explicitly stated the goals of "establishing a large enterprise group with annual sales of 3 billion yuan and six engineering technology R&D centers, with over two pharmaceutical companies going public," proposing to achieve these objectives through acquisitions and mergers. Consequently, 2005 saw a sudden surge in Foshan' s patent applications.

Figure 1 Foshan Biomedical Patent Application Trend

Further analysis of Foshan' s biomedical patents by filing country shows that the vast majority are Chinese patents, with overseas applications primarily filed through the PCT route. A small number of applications exist in the United States, Europe, Japan, South Korea, and other regions, reflecting that while Foshan' s patented technologies primarily target the Chinese market, there is growing attention to global layout.

2.2 Applicant Analysis

Statistical analysis of Foshan' s biomedical patent applicants reveals that most of the top 20 patent holders are local pharmaceutical enterprises and research institutes, including Foshan Saiweisi Pharmaceutical Company, Guangdong Juzhicheng Technology Co., Ltd., and Foshan Shunde Baotong Metal Technology Co., Ltd. The specific application volumes for the top five patent holders are shown below:

Table 2 Top 5 Patent Applicants in Foshan' s Biomedical Field

A bubble chart illustrates the comprehensive competitiveness of major Foshan biomedical patent applicants (Figure 2 [Figure 2: see original paper]), with three statistical dimensions: bubble size, horizontal axis, and vertical axis. Bubble size represents patent quantity, the horizontal axis indicates technological advancement level, and the vertical axis reflects corporate economic strength. The chart can be divided into four quadrants: the upper-right corner indicates stronger patented technology and greater economic strength, while the lower-left corner signifies weaker technology and poorer economic performance.

Figure 2 Bubble Chart Analysis of Major Foshan Biomedical Patent Applicants

The distance of bubbles from the origin reveals each applicant' s technological strength. Foshan Saiweisi Pharmaceutical Company' s bubble is positioned furthest along the horizontal axis, indicating its leading technological strength among all applicants and placing it in the first echelon. This demonstrates that Saiweisi Pharmaceutical is Foshan' s most technologically competitive pharmaceutical enterprise in this field. Applicants in the second echelon include individual inventor Yan Huaiwei, Guangdong Juzhicheng Technology Co., Ltd., and Foshan Shunde Baotong Metal Technology Co., Ltd. Bubble height reflects applicants' comprehensive economic strength—the higher the bubble, the stronger the economic power. Notably, Dow Chemical occupies the highest position with the strongest economic strength, though its technological strength and patent volume are relatively limited. The concentration of numerous patent entities in the upper portion of the third quadrant indicates that this technology field has attracted the attention of large local pharmaceutical enterprises and higher education institutions, making it a hot spot for Foshan' s technology R&D.

2.3 Industry Direction Analysis

Figure 3 [Figure 3: see original paper] Tree Diagram of IPC Statistics for Foshan' s Biomedical Patents

Figure 3 presents a tree diagram of IPC classifications for Foshan' s biomedical patents. Each irregular polygon represents an IPC main group, with its area size indicating the number of related patents. Red blocks represent fields with large global patent volumes, while blue blocks indicate fields with smaller global patent totals. The analysis shows that Foshan's biomedical patents primarily involve subclass A61K (preparations for medical, dental, or cosmetic purposes) of Section A, specifically concentrating on main group A61K36 (medicinal preparations containing material from algae, lichens, fungi, or plants). Additionally, testing reagents or methods G01N33 (investigating or analyzing materials by specific methods) account for a substantial proportion of applications, indicating patent concentration in these areas.

Further detailed analysis of Foshan' s biomedical patent applications and grants reveals: (1) Foshan' s earliest patent applications in chemical drugs date to 1998, with minimal volumes before 2004. In 2005, chemical drug patent applications

surged, likely driven by China' s WTO accession, which strengthened intellectual property protection for new drugs and prevented domestic pharmaceutical companies from freely imitating foreign drugs under patent protection. (2) Foshan' s patent applications in biological products are relatively few but show a high grant rate. Biological product pharmaceutical companies are innovative enterprises generally in the startup and development phase with strong R&D capabilities and promising growth prospects. (3) Foshan's medical device patent applications in the past five years total 143 cases, representing a relatively high proportion of total applications and demonstrating strong vitality and promising development trends. In 2006, the "China Medical Device (Sanshui) Industry Base" was officially inaugurated in the Central Science and Technology Industrial Park of Sanshui Industrial Zone, providing a national-level platform for developing Sanshui' s emerging medical device industry and further promoting Foshan' s medical device sector. By the end of 2011, the Guangzhou Branch of the Chinese Academy of Sciences signed a strategic development alliance with the Foshan Medical Device Industry Association, enabling Foshan' s medical device industry to rapidly connect with high-end technologies and accelerate industrial upgrading. (4) Foshan' s traditional Chinese medicine industry is a traditional specialty advantage sector, originating in the Ming Dynasty, flourishing in the Qing Dynasty, and boasting over 400 years of history. Consequently, Foshan enjoys reputations such as "the birthplace of Lingnan patent medicine," "the hometown of Guangdong patent medicine," and "the ancestor of Lingnan medicine." Since the reform and opening-up, Foshan' s traditional Chinese medicine has adopted advanced equipment and modern pharmaceutical production processes while inheriting the ancient "Foshan medicine"traditions of unique formulations, superior materials selection, and exquisite craftsmanship, embarking on a path of modern pharmaceutical development.

The detailed patent analysis reveals that these four major directions all represent either well-established foundations or promising prospects for Foshan' s biomedical industry development. Therefore, Foshan' s biomedical patents are categorized into four sectors: chemical drugs, biological products, medical devices, and plant-based medicines. The patent application volumes for each direction are statistically presented below. Table 3 shows that Foshan' s biomedical patents are primarily concentrated in the "plant-based medicine" direction, followed by chemical drugs and medical devices, while biological products show relatively few patents, indicating a need for enhanced patent application awareness in this sector.

Table 3 Patent Application Volumes for Foshan's Biomedical Industry Overall and by Direction

2.4 Specific Analysis of Current Status of Foshan's Biomedical Patents

Overall, Foshan's biomedical industry intellectual property development exhibits four key characteristics (as shown in Figure 4 [Figure 4: see original paper]).

Figure 4 Characteristics of Intellectual Property Development in Foshan' s Biomedical Industry

3 Comparison with Neighboring Cities

For comparative analysis with neighboring cities, Guangzhou and Shenzhen—two cities with more advanced biomedical industry development—were selected as benchmarks. The comparison utilizes key metrics including patent application and grant volumes and Patent Strength.

Patent Strength is a proprietary patent evaluation indicator developed by Innography, derived from the latest research by the University of California, Berkeley, Stanford University, the University of Texas, and George Mason University. Its purpose is to help users quickly and effectively identify core patents. Patent Strength references over a dozen patent value-related indicators, including the number of patent claims, number of cited prior art documents, citation frequency, patent and application families, application timeline, patent age, and patent litigation.

(1) Foshan

From 2,078 Foshan biomedical patents, the system automatically retained the highest-strength patent from each family. After sorting by Patent Strength, 95 medium-to-high-strength patents (30% strength) were retained. Among these 95 patents, 12 (70% strength) were classified as high-strength patents.

(2) Guangzhou

Figure 5 [Figure 5: see original paper] Distribution of Patent Strength for Foshan' s Biomedical Patents

In 2007, Guangzhou became a National Bio-industry Base City and a National Medicine Export Base City. It is China' s most concentrated and advantageous city for the medical and health industry, with abundant medical resources, a strong pharmaceutical culture, and a solid industrial foundation. As South China' s medical center and pharmaceutical distribution hub, Guangzhou ranks third nationally in medical resource ownership and has formed a diversified industrial service network comprising medical treatment, health care for the elderly, medical care, and health insurance, serving South China and even Southeast Asia. By 2014, statistics indicated that Guangzhou' s biomedical industry generated approximately 150 billion yuan in main business revenue and about 45 billion yuan in added value, with increasingly prominent advantages in industrial scale and efficiency [8].

Guangzhou' s biomedical field yielded 5,672 patent applications, including 2,367 granted patents with a grant rate of 41.7%. Currently, 1,805 patents remain

valid, while 1,806 are under examination. Valid granted patents account for 31.8% of total applications, with patents under examination representing 31.8% of the total.

Table 4 Overall Status of Guangzhou' s Biomedical Patents

From 5,672 patents, the system automatically retained the highest-strength patent from each family. After sorting by Patent Strength, 262 medium-to-high-strength patents (30% strength) were retained, including 3 high-strength patents (70% strength). Compared with Foshan, Guangzhou has 2.7 times more medium-to-high-strength patents but fewer high-strength patents.

Figure 6 Distribution of Patent Strength for Guangzhou's Biomedical Patents

(3) Shenzhen

Over the past five years, Shenzhen' s bio and life health industry has grown rapidly at an average annual rate of 20%. In 2015, Shenzhen's bio-industry scale reached approximately 200 billion yuan, with stem cell and tumor immunotherapy, gene therapy, and other biomedial industries having a solid foundation, with some fields achieving international leadership. Shenzhen' s biomedical field yielded 2,218 patent applications, including 888 granted patents with a grant rate of 40.0%. Currently, 702 patents remain valid, while 663 are under examination. Valid granted patents account for 31.6% of total applications, with patents under examination representing 29.9% of the total (detailed statistics are shown in the table below).

Table 5 Overall Status of Shenzhen' s Biomedical Patents

From 2,218 patents, the system automatically retained the highest-strength patent from each family. After sorting by Patent Strength, 139 medium-to-high-strength patents (30% strength) were retained, including 8 high-strength patents (70% strength). Compared with Foshan, Shenzhen has 1.5 times more medium-to-high-strength patents but fewer high-strength patents.

Figure 7 [Figure 7: see original paper] Distribution of Patent Strength for Shenzhen' s Biomedical Patents

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4. Recommendations for Foshan' s Biomedical Industry Development

According to the "2016-2020 China Biomedical Industry Cluster Development Model In-depth Analysis and Development Strategy Research Report," China' s biomedical industry clusters are becoming increasingly evident, initially forming a spatial pattern with the Yangtze River Delta and Bohai Rim as the core, and the Pearl River Delta and Northeast China as rapidly developing regions [9].

The report notes that the Pearl River Delta region features a mature market economy system with enormous market potential. Foshan' s location in this region, coupled with its well-developed pharmaceutical distribution system, proximity to Hong Kong and Macau, strong external radiation capacity, and active private capital, creates favorable conditions for industrial structure upgrading, accelerating the construction of a modern industrial system, and achieving the strategic transformation from "Foshan Manufacturing" to "Foshan Services." This positions Foshan to become a hub for attracting high-tech talent from home and abroad.

Foshan New City has designated the biomedical industry as a regional leading industry, introducing high-end industrialization and innovation teams, gathering and cultivating outstanding talent, constructing engineering centers, key laboratories, and high-end industrial service platforms, and enhancing local biomedical industry technological innovation capabilities. Through diversified cooperation models, it collaborates with local medical institutions, universities, and enterprises to conduct forward-looking and regional biomedical project joint research. Meanwhile, Chancheng District Government has established a strategic partnership with Sino-Zhongda Yi, providing support funds, talent policies, and tax incentives to promote enterprise development and growth.

Based on the current status of global and Foshan biomedical patents, we propose the following recommendations to further overcome difficulties and problems in accelerating industrial development by enhancing patent utilization awareness:

(1) Enhance Patent Protection, Management, and Utilization Awareness

Intellectual property is a crucial legal system for promoting technological innovation, accelerating the industrialization of high-tech achievements, and enhancing economic competitiveness. However, enterprises, research institutions, and hospitals in Foshan currently maintain weak awareness of intellectual property and patent protection. Intellectual property should be regarded as property and capital to rapidly patent innovative achievements. To improve patent protection awareness in Foshan' s biomedical sector, we recommend strengthening training on intellectual property utilization and management, establishing internal evaluation systems, and managing the entire patent lifecycle. This will enable Foshan' s biomedical patent technology to catch up quickly.

Due to the legal attributes of patents, their status continuously changes throughout their lifecycle, affecting infringement risks. We recommend that the Foshan government support local enterprises in establishing effective patent management systems. By fully implementing GB/T 29490-2013 "Enterprise Intellectual Property Management Standard," enterprises can standardize management of the entire patent lifecycle, including creation, utilization, management, and protection. For currently granted patents and those under examination, we recommend establishing internal evaluation systems to assess whether existing

patents should be maintained, ensuring important patents remain in force. For newly developed technical solutions preparing for patent application, management processes can be further improved through unified management of proposals, drafting, examination, agency, and fees. Conducting intellectual property standardization implementation will help local enterprises rapidly improve their intellectual property management quality.

(2) Optimize Industrial Structure and Layout, Adopting Differentiated Development Approaches

Although Foshan' s biomedical patent applications have grown rapidly in recent years, they are concentrated in traditional plant-based medicines and chemical drugs, while biological product-related patents remain in the exploratory phase. Countries worldwide prioritize the biomedical industry as a strategic sector for the 21st century, formulating development plans and increasing policy support and capital investment. In recent years, China has continuously increased support for the biomedical industry, particularly in the 12th Five-Year Plan, which identified the bio-industry as one of seven strategic emerging industries, establishing its strategic position in the national economy. The latest government work report explicitly proposed cultivating the biomedical industry as a leading sector for the first time, injecting strong momentum into industry development.

Analysis of patent competition in the diagnostic reagents subsector of biological products reveals that multinational pharmaceutical companies attach extreme importance to R&D and market layout for diagnostic reagent technologies, maintaining active patent portfolios with intense competition. Currently, domestic research in this field remains at the scientific research stage, allowing imported diagnostic reagents to monopolize the domestic market to some extent. We recommend actively guiding pharmaceutical enterprises toward the biological products sector, focusing on introducing components, equipment, and other projects related to diagnostic reagent industry development to expand and improve the industrial chain.

For patented technology development in different subsectors, full consideration should be given to combining subsector conditions with Foshan' s unique patent advantages to plan practical and feasible development models. Specific development model recommendations for each subsector are as follows:

(3) Enhance Competitiveness of Existing Technologies

Figure 8 [Figure 8: see original paper] Recommended Development Models for Foshan' s Biomedical Subsectors

Foshan has relatively large patent application volumes in plant-based medicines and chemical drugs, accumulating certain technical experience in these two directions. Notably, Foshan Saiweisi Pharmaceutical Company ranks among the top 20 international patent applicants in the Type 2 diabetes chemical drug

field. However, overall technological and economic strength still requires further improvement, with significant gaps remaining compared to foreign pharmaceutical companies. For mature pharmaceutical technologies with long-term accumulation, we recommend that local enterprises drive core patent technology R&D to achieve technological upgrading. This can be accomplished by studying medium-to-high-strength patents from key international patent holders to overcome technical bottlenecks and break through existing domestic technological barriers. Alternatively, enterprises can collaborate with domestic universities (such as the Chinese Academy of Sciences and China Pharmaceutical University) or obtain patent licenses to rapidly integrate cutting-edge technologies with industrialization from an industrial chain perspective through patent transfer and transformation, thereby enhancing core competitiveness.

(4) Establish Risk Early-Warning Mechanisms and Deliver Patent Information Services

As patent status continuously changes, infringement risks evolve accordingly. Foshan can purposefully establish a patent risk early-warning mechanism around its biomedical industry patent navigation platform to conduct real-time risk monitoring and deliver timely patent information updates to local enterprises. Recommended monitoring contents include:

- For Type 2 diabetes chemical drugs: focus on patent families, grant status, and new litigation in the Americas and East Asia (including the United States, Japan, China, and Canada).
- For rheumatism plant-based medicines: focus on domestic applications and those in the United States, Japan, and South Korea.
- For immunodiagnostic reagents: focus on the United States, Japan, Germany, and the United Kingdom.
- For nursing beds: focus on the United States, Japan, and China.

Monitoring should also track patent applications and grant status of key applicants in China, particularly patent assignment and licensing by multinational corporations. Key patent holders in Type 2 diabetes chemical drugs include Pfizer, Merck Sharp & Dohme, Sanofi, and Roche. In immunodiagnostic reagents, key holders include Roche, GlaxoSmithKline, Novartis, Thermo Fisher Scientific, and Abbott. In nursing beds, key holders include Hillrom, Paramount Bed Co., Ltd., Getinge Group, Stryker Corporation, and Panasonic. Additionally, we recommend monitoring the latest technological developments of domestic entities with existing patent portfolios (such as Suzhou Aijie and Beijing Qinbang in diagnostic reagents, and Anhui Medical College and the Fourth Military Medical University of the Chinese People' s Liberation Army in nursing beds). Through real-time monitoring of these contents, the Foshan government can deliver relevant latest patent technology information through the navigation platform, helping enterprises stay informed about the latest developments in their technology fields and adjust technical routes or patent layout plans promptly.

(5) Optimize the Development Environment

We recommend increasing policy support for Foshan enterprises, particularly leading companies in the biomedical field. Foshan has many individual inventors (such as Yan Huaiwei) rather than enterprises or institutions. We suggest conducting field research on key inventors and providing prioritized support for production land needed by high-tech inventors to accelerate patent technology industrialization. The municipal government should formulate preferential policies for overall economic development to attract more non-local enterprises and retain local ones. Preferential policies should be granted based on enterprise scale, tax contributions, and employment numbers, including preferential land prices for headquarters building construction in central business districts or other prime locations. For leading enterprises and key units such as Foshan Saiweisi and Foshan Liqiang Medical Equipment Co., Ltd., as well as the Chinese Academy of Sciences, we recommend accelerating the construction of high-tech talent residential areas to improve living conditions and retain both enterprises and talent.

In summary, in Foshan' s biomedical technology field, the municipal government requires effective patent development strategies to support the healthy development of local enterprises. It should optimize industrial structure and layout in alignment with strategic emerging industry guidance policies, provide relevant patent information services, and holistically plan effective patent development strategies from technological, geographical, and major patent holder perspectives to achieve transformation and upgrading. Simultaneously, it should optimize the development environment to attract top-tier talent, improve patent management systems, and build a complete biomedical and health industry chain.

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Note: Figure translations are in progress. See original paper for figures.