Chapter 3
Regionalized Management of Clinical Gene Sequencing in Application: An Example and Proposal of Haixi Economic Zone

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Abstract The economic zone on the west side of the Straits (Haixi economic zone) refers to the west bank of the Taiwan Strait. It is located in Fujian Province and includes some cities in Zhejiang, Guangdong, and Jiangxi. Haixi economic zone is a comprehensive region covering economy, politics, culture, society, and other fields. With the rise of national strategy, Healthy China, a series of policies has been urgently issued to support the development of health industry, and the genetic testing industry has shown a vigorous development trend. An organization is required to promote the research and application of new technologies and the development of

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H. Shen et al. (eds.), *Regionalized Management of Medicine*, Translational Bioinformatics 17, https://doi.org/10.1007/978-981-16-7893-6_3

the genetic testing industry. By forming a genetic testing alliance and establishing a big gene data center, the regional management can be realized, data sharing can be promoted, and a large database of pathogenic mutations can be improved.

Keywords Haixi economic zone · Genetic testing · Regional management · The west coast of the Taiwan Strait · Precision medicine

3.1 Regional Introduction

3.1.1 Geographical Location of the Haixi Economic Zone

The Haixi economic zone locates in the west bank of the Taiwan Strait, with Fujian as the main part and covering Zhejiang, Jiangxi, and Guangdong provinces. In addition to covering all prefecture-level cities in Fujian Province, it also includes Wenzhou, Lishui, and Quzhou in Zhejiang Province; Shantou, Meizhou, Chaozhou, and Jieyang in Guangdong Province; and Shangrao, Yingtan, Fuzhou, and Ganzhou in Jiangxi Province (Fig. 3.1). The Haixi economic zone is a comprehensive area covering economic, political, cultural, social, and other fields. Its overall goal and task is to basically realize economic integration, investment and trade liberalization,

Fig. 3.1 Geographical location of the Haixi economic zone. The Haixi economic zone is located on the west bank of the Taiwan Strait, with Fujian as the main body, covering parts of Zhejiang, Jiangxi, and Guangdong Province. It is an economic complex

unification of macro policies, advanced industrialization, regional urbanization, and social civilization through "opening to outside world, coordinated development, and overall prosperity."

The history of constructing urban agglomerations on the Haixi economic zone can be traced back to the concept of the "Southern Fujian Golden Triangle" proposed by Fujian in the late 1980s. In 2004, Fujian Province formally put forward the strategic concept of "The Economic Zone on the West Side of the Straits." In 2009, the State Council issued the *Several Opinions of the State Council on Supporting Fujian Province to Accelerate the Construction of the Haixi Economic Zone*. In 2011, the National Development and Reform Commission issued the full text of *The Development Plan of Haixi Economic Zone*; the plan pointed out that the Haixi economic zone will be built into a scientific development zone, a reform and opening up zone, a civilized and peaceful zone, and an ecologically beautiful zone and become a new economic growth zone in China.

3.1.2 Cultural Characteristics of the Haixi Economic Zone

As the largest urban agglomeration across provinces, Haixi is facing a sense of fragmentation that is difficult to reconcile. Cities in Zhejiang and Guangdong are more inclined to the Yangtze River Delta and the Pearl River Delta. Cities in Jiangxi are also in the planning of the Poyang Lake City Cluster. The main force of the Haixi urban agglomeration is the coastal cities in Fujian. The Haixi economic zone has strong characteristics of marine culture, presenting a diversified structure and regional distribution characteristics, mainly including the Minnan culture, Shipping culture, Mazu culture, Hakka culture, Tea culture, Zhuzi culture. and She nationality culture. These cultural brands represent image of Fujian and highlight Fujian people.

The Minnan region locates in the southern part of Fujian Province. Because of the special geographical location, the Minnan culture has a pivotal significance in the entire Haixi culture. Minnan culture is a derivative of Heluo culture. It is the fusion of Central Plains culture and local culture, which gives Minnan culture the characteristics of mainland culture. At the same time, Minnan culture has the characteristics of Marine culture, and it exports culture and materials to the outside world, and it also receives input in exchanges. Minnan people have a strong concept of clan, which originated from the migration of the Central Plains to Fujian, where they lived in the form of clan. So far, there is still the consciousness of cultivating genealogy, building ancestral temples, and spreading customs. This makes Minnan people have unusual cohesion when they develop abroad (Liang and Song 2018).

3.1.3 Public Health Development in the Haixi Economic Zone

The *Outline of the Eleventh Five-Year Plan for National Economic and Social Development of Fujian Province* clearly requires that the urban and rural public health service system should be improved and perfected to be compatible with the growth of the Haixi. However, current regional government is inconsistent and uncoordinated in public health needs and provision, public health awareness and knowledge, and social development and economic development: firstly, severe situation of prevention and control of public health emergencies; secondly, most primary medical institutions do not have advanced equipment and timely emergency response and comprehensive service capabilities; and finally, lacking public health knowledge of urban and rural residents. The term "public health" is simply understood by many people as clean environment, and urban and rural residents lack basic knowledge of public health.

3.1.4 Economic Development in the Haixi Economic Zone

At present, the economic development of the Haixi economic zone is still uneven. The economic development of the entire economic zone mainly depends on Fujian, and most of economic data of the nine cities in Fujian is in a leading position. Among Haixi area, the economic development of coastal cities has limited capacity to cover inland hinterland and mountainous cities. Except for some cities in Jiangxi Province, which all locate inland, the economic development level of coastal cities in other provinces is higher than that of inland. From view of the Haixi cities, the basic situation of strong coastal areas and weak inland areas has not been effectively improved. Xiamen, Fuzhou, Wenzhou, and Quanzhou have kept their positions as the central cities on the Haixi. Zhangzhou is catching up with Shantou with a faster economic growth rate, and it is expected to become one of the central cities in the future.

Comparing the main economic data of the Haixi economic zone with three major urban agglomerations in the eastern coastal area, the Yangtze River Delta, Greater Bay Area, and Beijing-Tianjin-Hebei, a gap exists in the main economic data. At present, Haixi cannot be compared with other economic zones. But its foundation and relevant development does help to the economic growth rate which far exceeds that of the other three economic zones. This shows that the economic structure of the Haixi economic zone is reasonable and healthy, with strong vitality, and has embarked on the fast track of rapid development.

3.2 Genetic Testing

Before the molecular structure of double-stranded DNA was verified, human knew nothing about genes, but had a rough understanding of heredity. An old saying in China which basically means "you reap what you saw" shows ancestors' insight into the "genetics." The Human Genome Project has been launched over 30 years, which marks the beginning of this achievement to catalogue every human gene and identify each of their genomic function patterns. Novel features of this program include the capacity to automatically predict multiple genes by sequencing technology, and nowadays, researchers have a deeper understanding of these genes (Kirkpatrick and Rashkin 2017).

The advancement of gene technology has brought an unprecedented innovative revolution (Katsanis and Katsanis 2013). Genetic testing as a basic screening and testing tool has also played an important role in the advanced service and manufacturing industries and refilled the context of public health strategies in various countries. The *Bio-industry Development Plan* issued by the State Council at the end of 2012 pointed out that the bio-industry is a strategic emerging industry identified by the state and is expected to become a pillar industry of country's economy by 2020. The major breakthroughs made in genomics-related advances in the past few decades have brought great reformations to diagnosis of diseases. The genetic testing helps doctors to make recommendations for treatment or monitoring, give the patients or consumers more information for making decisions about their health, and identify genetic disorders early in life so treatment can be started as soon as possible.

3.2.1 The Epidemiological Statistics of Genetic Diseases and Tumors in Haixi Economic Zone

Tumors have become one of the main burdens to the growing economy worldwide. According to *the 2014 Fujian Malignant Tumor Report* published by the Fujian Cancer Prevention and Treatment Office, out of every 100,000 people, nearly 279 people have tumor, and 164 people die of cancer. It can be seen that cancer has become the main cause of mortality in Fujian residents. More specifically, according to the data from the Second Affiliated Hospital of Fujian Medical University in Quanzhou, the most economically active region on the Haixi economic zone, of the 20,000 malignant tumor patients, lung cancer, colorectal cancer, esophageal cancer, thyroid cancer, breast cancer, gastric cancer, liver cancer, oral and pharyngeal malignancies (of which nasopharyngeal cancer accounts for a quarter), lymphoid hematopoietic system tumors, and cervical cancer, are the highest incidence cancer types in this area (Fig. 3.2). Chaozhou-Shantou area also has several so-called Cancer Town with high incidences of certain cancer types, which by virtue of being surrounded by chemical or coal-fired power plants. According to the Cancer

Fig. 3.2 Cancers with high incidence in Haixi economic zone. According to the data of cancer patients at the Second Affiliated Hospital of Fujian Medical University in Quanzhou, the top ten high-incidence cancers in this region are lung cancer, colorectal cancer, esophageal cancer, thyroid cancer, breast cancer, gastric cancer, liver cancer, oral and pharyngeal malignancies (of which nasopharyngeal cancer accounts for a quarter), lymphoid hematopoietic system tumors, and cervical cancer, which are related to many factors such as climate, living habits, pollution and dietary habits

Hospital of Shantou University Medical College, the major cancer in Chaozhou-Shantou area was esophageal cancer, followed by bronchial lung cancer, breast cancer, and gastric cancer over the years.

Together, the cancer types in the Haixi region have regional specificities. Among them, esophageal cancer, thyroid cancer, nasopharyngeal cancer, gastric cancer, and liver cancer are regionally high, which is related to many factors such as climate and living habits. The subtropical climate in coastal areas will give rise to more cancer risks through exposure to carcinogens after extreme weather events like hurricanes and wildfires (Hiatt and Beyeler 2020). Besides, a few epidemiological studies have addressed the link between the association of esophageal cancers with tea consumption regarding frequency, amount consumed, and temperature (Yu et al. 2018; Islami et al. 2020). The results are conflicting but in general highlight the importance of abstaining from hot tea drinking habits in excessive alcohol and cigarette consumers. However, the influential tea culture has a strong effect on eating habit. They like eating hot foods and drinking hot tea, which will easily cause damage to the esophageal mucosa, creating conditions for the growth of carcinogen aflatoxin,

thus increasing the risk of esophageal cancer and liver cancer. In addition, the crisscrossing distribution of rivers in this area is more likely to worsen water pollution with heavy metal and a relatively high infection rate of viral hepatitis in coastal areas. Moreover, it's said that thyroid cancer is often related to high-iodine dietary habits such as seafood and kelp. Residents in coastal areas like pickled foods, which contain high levels of carcinogens or pre-carcinogens such as nitrites, mycotoxins, and polycyclic aromatic hydrocarbon compounds, leading to a gradual increase in the incidence of gastric cancer. In the meantime, *Helicobacter pylori* has been proved to have a role in promoting the conversion of nitrate into nitrite and nitrosamine, and it can also cause chronic inflammation in gastric mucosa, accelerating the excessive proliferation of mucosal epithelial cells, leading to aberrations and carcinogenesis.

The gene testing technology is an important tool that will promote clinical genomics development and realize personalized precision medicine (Slomski 2016). It can be used not only to screen the population for high risk of certain hereditary cancers but also to clarify the characteristics of genetic mutations in cancer patients. It enables patients to benefit from cancer target therapy. From above, the occurrence and development of tumors in the Haixi economic zone have obvious characteristics of "clustering and regional." In-depth studies such as gene sequencing of these cases are urgently needed to help prevent tumor occurrence at the genetic level and promote the development of oncology. Thus, it is necessary to widely popularize gene testing in the Haixi economic zone.

3.2.2 Current Genetic Testing in the Haixi Economic Zone

Although genetic testing technology helps to achieve the goal of personalized medicine, especially for promoting the development of oncology, it still hasn't been extensively spread among the people. At present, in the clinical field, genetic testing is usually used to assist clinical diagnosis, which is mainly reflected in the detection of genetic defect diseases and tumor mutation. The most mature and representative genetic testing service is noninvasive prenatal genetic testing. The advantages of genetic testing are listed as follows: (1) predictive medicine, (2) disease prevention, (3) health management, and (4) personalized medical services. The specific application directions of genetic testing include (1) tumor diagnosis and treatment, including blood system tumor diagnosis and typing, targeted drug gene detection, tumor susceptibility gene detection, and early tumor screening; (2) birth defect prevention and control, mainly including prenatal screening and diagnosis, screening of neonatal metabolic diseases, etc.; (3) diagnosis of genetic diseases; (4) diagnosis of pathogenic microorganisms; and (5) detection of chemical drug sensitive genes such as anticoagulant drugs.

On June 26, 2000, the United States, China, Japan, Britain, France, and Germany jointly announced that the "work map" of the Human Genome Project was completed. This marks the human life sciences entering the era of gene applications. The

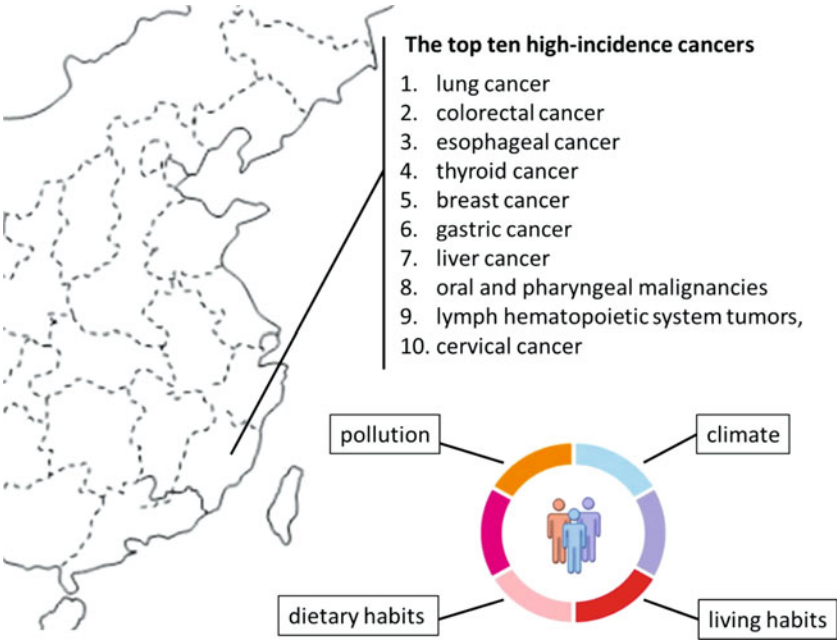

Fig. 3.3 Genetic testing in the Fujian Province. In Fujian Province, there are few genetic testing companies. They are mainly concentrated in Xiamen (preliminary statistics of 12) and Fuzhou (preliminary statistics of 10). In Quanzhou, only HiQ Biomedical Clinic Laboratory undertakes part of the testing projects

gene sequencing enterprises in China are mainly concentrated in the downstream sequencing service industry of the industrial chain, while the upstream gene sequencing equipment suppliers have a high technical threshold, which is basically monopolized by foreign enterprises. The development of genetic testing industry in Beijing, Guangdong, and Shanghai has a leading position in this industry. In addition to the advantages of local talents and capital resources, local industrial policies also play a vital role. Unfortunately, there are few big genetic testing companies in the Haixi region. Most biological companies are concentrated in Xiamen (preliminary statistics of 12) and Fuzhou (preliminary statistics of 10) (Fig. 3.3). In Quanzhou, only the Gaopin Medical Testing Center undertakes part of the testing projects, which covered the tumor mutation detection and defected genetic disease testing. Relatively fewer gene testing companies in other regions have been established. This third-party testing currently uses multi-platform sequencing technology to conduct a full range of research on diseases at the DNA level, RNA level, epigenetic level, and metagenomic level, and combines mass spectrometry technology to carry out proteome level research. The massive data obtained from the research platform, combined with various information related to the phenotype (environment, age, disease treatment history, family history, susceptibility, etc.), have a potential to fully reveal the mechanism of human genetics that

laid an important foundation. Genetic testing also involves single-cell research, immune repertoire research, and liquid biopsy.

Although the Haixi economic zone has a prosperous economic growth, the genetic testing platform in the region has not yet been well established; thus, it is hard to fully use the implementation of genetic testing, as said before. To better serve and reduce diseases, we should gradually improve the framework and rules of the Haixi genetic testing platform; maintain efficient communication with the government, medical insurance, outsourcing service agencies, and other stakeholders to form a gene sequencing plan in the region; and explore the data sharing incentive mechanism, participation in the implementation of clinical trials, and systematic data collection issues to overcome clinical application difficulties.

3.2.3 Opportunities and Challenges for Genetic Testing

The current genetic testing business is in a dilemma in Haixi areas (Ramos and Haidle 2018). In general, medical management strategies in Fujian Province are too strict to fully delegate to process all professional inquires or customer-focused solutions. Also, various product qualifications and prices restrict the application of many innovative products. A large number of challenges should be overcome, for example, there is no integrity professionalism service model. The business cooperation model for now is mainly to directly sell test kits to consumers through online or offline, like in pharmacy. After customers done the sample collection according to the instructions, the company collected samples to do test and issued a personal genetic test report. Also for the medical-grade genetic testing, the operation team collect blood samples in clinics sporadically and sent it back to the company to finish the process. Without corresponding standard protocols, it may pose many risks, such as sample loss, destruction, and information errors.

There is a lack of a supervision platform. Regarding the perspective of detection capabilities, each third-party service company may differ from each other. In an era where gene testing needs are skyrocketing, the efficient allocation of resources is paramount. These not well-qualified companies may take the market share by adopting layer-to-layer subcontracting methods, which could directly affect the authenticity and reliability of the results. From the perspective of industry structure, due to the lack of corresponding industry standards, product price and qualities and other issues involved in genetic testing have not been clearly regulated, which may lead to vicious price competition and hinder the development of the entire genetic testing industry.

To ensure the security of data information is a challenge. Each individual has unique genetic information that should be adequately protected within the scope of personal privacy. Under the current business cooperation model, patients cannot fully protect their vital interests and rights, which results in a lack of trust and recognition in the industry psychologically. There are few services that can be carried out. Most tumor-related gene test kits and microbiological test reagents

have not obtained its clinical testing licenses, so the genetic testing projects carried out in hospitals of Haixi economic zone only include a few testing projects such as prenatal screening NIPT testing and tumor-targeting gene EGFR.

With low customer awareness and lack of trust, people still hold the opposite view that genetic testing was only the high-tech product that has no close connection to their health. Most service teams in genetic testing market does not have professional knowledge and cannot provide professional preventive guidance services or genetic counseling services on the results. There is a greedy need for relevant organizations to promote the application and research of new technologies. As the most important institute to protect life and health, the hospital contains various favorable conditions for carrying out genetic testing, including health professionals, well-equipped technology settings, and an original source of patients. It can ensure that patients or customers not only get the best care over a continuum of time to achieve positive clinical outcomes, but also that appropriate utilization for optimal patient care is being followed. At the same time, by setting up a genetic sequencing laboratory, the hospital can greatly reduce the cost of testing and shorten the turnaround time. However, there are still the following difficulties in carrying out in-hospital genetic testing. There is a lack of hardware platforms (data centers) within hospital, although currently few hospitals have established large-scale genetic data centers. It can be hard to keep up with the digital age when data is rapidly being processed and transferred. Few institutes have administrative staff or technical support. It is also difficult to make full use of data sharing.

Thus, a bigger genetic testing consortium should be formed in Haixi economic zone. And a combined hardware and software company should also be included in the consortium to ensure that data gathering and statistical reporting processes meet essential guidelines, as well as fulfill data sharing systems to benefit more researchers.

3.3 Regional Management

Regional management is an important way for the Haixi economic zone to carry out genetic testing projects (Gatellier et al. 2020; Sarcone and Kimmel 2021). The regional consortium will break the original barriers to a certain extent, unblock genetic testing channels, and realize the sharing of high-quality resources.

Regional management firstly requires the establishment of regional organizations: strategic team, management team, and executive team. The strategic team is in charge of the regional health units. The health committee officers and organizations directly under the jurisdiction form a leading group that is responsible for formulating policies and guidelines and also setting the strategic goals. The management team was founded by the leading group and its subordinate permanent office, and the management department within the consortium. The management department is responsible for authenticating and authorizing third-party service, and carrying out technical management and security level assessment of medical

institutions in the jurisdiction. The executive team is composed of various units in the consortium, and is responsible for the implementation of sample collection, data collection, and data integrity.

In order to effectively carry out the program to the highest quality gene testing service, the pre-work can be mainly divided into the following steps: First, conduct surveys and market forecasts and analyze the demand and feasibility of genetic testing cores according to the disease epidemiology. Second, a necessary market promotion is needed in the beginning. Advertising, paper news, and other marketing methods help expand the visibility and recognition of genetic testing. Third, organize investment promotion activities at designated locations. According to the distribution of hospitals and testing institutions, establish genetic testing stations and substations to seize market shares in key regions. Fourth, provide training and technical support. Technical personnel and franchising organizations should be given corresponding skills training to improve their vocational skills and professionalism.

In the process of project development, it is necessary to first strengthen marker supervision to ensure every team adheres to strict regulatory guidelines by setting up a special team to conduct yearly or monthly inspection to solve the difficulties when doing the project timely. Second, increasing the propaganda methods like social media, online app, or welfare TV shows to derive the most value of the gene testing results and improve the identification, recruitment, and engagement of patients eligible for clinical trial. Finally, enough funding should be guaranteed. With the rise in the awareness of public health, more capitals should be induced to implement the genetic testing industries.

In the context of medical big data, the awareness of ensuring data security should run through the entire process. After each genetic testing project has been completed, medical records should be well recorded into a case database and big data files, and well protected from the entire life of data like during generation, collection, and transmission process. Attention should be paid to all links such as storage, processing, analysis, release, use, and destruction. This requires a centralization of management, with regional coordinate operating mechanism. There are several details included: First, the information management department of health organization can set up a data security and maturity level evaluation system to conduct data security evaluation on the subregions under its jurisdiction and medical institutions under its management. With this system, basis guidelines can be formulated to guide the security plan and set up a threshold to the accessibility to secured data. Second, define data ownership and privacy protection content around the entire life cycle of data from generation to destruction. Third, conduct data security management from three dimensions of guideline: organization, management, and technology. For example, in terms of technology, a complete safe operation platform, data security system, and data security services are required to enable faster clinical transformation of gene sequencing results.

An important feature of regional management is the establishment of regional cooperation system. Strengthening the cooperation relationship within the zone is an essential way to accelerate the development of genetic testing and also a goal that

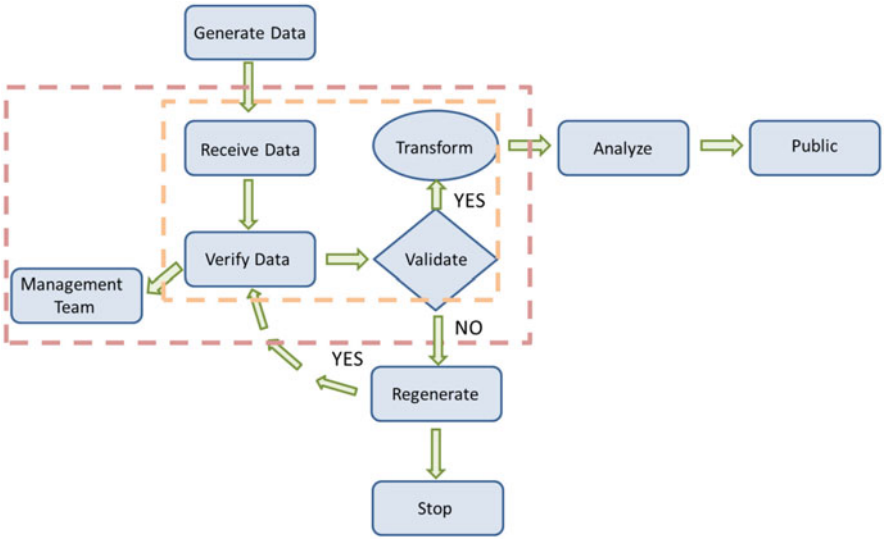

Fig. 3.4 The flowchart of data governance. Through the process of data governance, we can make the results more accurate and reliable

should be well achieved by the consortium. To implement inter-regional cooperation, a mechanism to promote regional interaction and overall development should be established. This mechanism should include the cooperation of city groups involved in the Haixi economic zone and, most importantly, the surrounding region such as Pearl River Delta and Yangtze River Delta economic zone. Annual meetings should be held regularly to exchange the ideas and learn from other regional cooperation systems. By doing this, the consortium could better adjust plan and coordinate major issues in the region as a whole.

On the other hand, the Genetic Testing Professional Society of Haixi economic zone should be formed to connect the government, industry, university, and research groups to serve the integration of technology and economy (Fig. 3.4). The society will establish an expert advisory committee which is composed of experts in related fields to carry out investigations and discussions on major issues in the development of genetic testing technology, guide the development of the society, and enhance independent research and development capabilities. The society will promote the exchange, sharing, and cooperation in different fields related to genetic testing, such as medical and health, life omics, big data, policy research, and financial investment. The society will implement projects, enable the development of genetics, and give full play to the influence of the platform. The platform can also unite workers in multiple industries, such as medical care, life omics, and big data analysis. By closely contacting with government departments, it could also promote collaboration between political officers, business industry, academia, and research group, to urge the industry in the direction of scientific standardization and promote medical research to fully use the advantage of genetic testing.

A strong membership structure of gene test platform covers the entire industry chain of genetic testing. The medical branch is set up with the application of genetic testing as the main line. The society can establish a systematic branch structure based on the three major categories of reproductive health, tumor prevention and control, and pathogen detection. The society should integrate technological alliances and promote the development of the industry with the quality control center as the starting point. The clinical genetic testing quality control center is needed to condense a large number of expert resources in genetic disease testing, tumors, cardiovascular diseases, infectious diseases, genetic counseling, and other disciplines to promote and standardize the quality control of related clinical genetic testing. A consortium of Haixi economic zone genetic testing alliance can serve the development of technological and economic integration. The alliance breaks industry restrictions, field restrictions, and professional restrictions between different institutions. By the integration of basic research, achievement transformation, promotion and application, property rights protection, investment and financing, industry promotion, government support, and other resources in the whole chain, the deep integration of technology and economy will be realized.

3.4 Consortium/Society Benefits

Next-generation sequencing (NGS) has been used for genome sequencing for over 30 years, but their high throughput also makes them popular in the field of functional genomics assays. It has been widely used worldwide for prevention of hereditary gene defect disease, designing precision treatment strategy of malignant tumors, and accelerating breakthroughs – life-changing breakthroughs that enable patient with tumor to live longer and get through pandemics, like the COVID-19. Genetic testing technology is a major revolution in the development of life science and biotechnology. It's one of the most important methods of healthcare service which can help in determining the risk of developing certain kinds of diseases as well as screening and sometimes medical treatment. As the healthcare service is booming, the genetic testing service will also be the industry with the greatest potential and longest acceleration in output.

Currently, only a small scale of well-educated people in Haixi economic zone are aware of the importance of gene test, but very few methods can be approached. As a result, accelerating the establishment of modern health service consortium can be a very powerful method to enhance the comprehensive competitiveness of the cities by expanding the scope of employment, improving people's living standards, and promoting the regional economic structure and the overall development of the institute in the consortium. At the same time, the genetic test consortium will also become one of the main driving forces of the new economic growth. A sound system can reduce sample transaction costs, simplify the workflow, and achieve economic expansion within the consortium. It can also help focusing on the role of industrial upgrading and structural change across the related social gains.

By establishing a diversified, networked, and standardized genetic testing institution, medical organizations, universities, scientific institutions, and research centers can be well qualified for the innovation capabilities in the Haixi economic zone as an alliance. With diversified investment entities and market-oriented operating approach, the society can meet the rapid development of cooperation and genetic testing in the area. Regional centers should be encouraged to gradually form a healthy network and build a public genetic testing service platform. Meanwhile, big data sharing system and analysis platform should also be fully operated by professional personnel. The genetic testing society, in other means, can be a compatible discourse system to communicate with partners and interest alliances outside of the society. The establishment of a diversified, standardized, and well-connected network can also be a good example for the country or even international gene testing industries.

Consortium/society should support the expansion of service category and technological development. The main services can be dispersed to different sections to fully cover the services required by the public and academic research group: reproductive health services, complex disease services, basic scientific research services, and drug research and development services. First of all, encourage qualified cities and counties to carry out prenatal genetic testing and screening projects. Compared with the traditional amniocentesis technique, which is the most commonly used prenatal testing for pregnant women, noninvasive prenatal genetic technology can alleviate the pain of pregnant women and reduce the risk of abortion. However, the quick unpainful test can also determine the risk that the fetus will be born with certain genomic abnormalities. Therefore, the establishment of noninvasive prenatal screening services in local hospitals that can provide regular pregnancy checkups for pregnant women can indeed increase the popularity of the industry. Second, support the establishment of precision medicine centers relying on qualified medical institutions, and use genetic testing technology to carry out precision medicine and individualized medicine to improve the effectiveness and safety of treatment. Encourage qualified medical, medical education, and scientific research institutions to carry out the clinical application of laboratory research and development tests in accordance with laws and regulations, and carry out the prediction, early diagnosis, and individualized treatment of major diseases. Tumor diagnosis and treatment has been currently well studied in research field; thus, cancer genetic testing should become the most power weapon to eliminate cancer burden. Tons of evidence have shown that tumor genetic testing can effectively assist early diagnosis and further guide individual treatment, and extend the life and quality of life of cancer patients. For example, in lung cancer, targeted therapy has greatly improved the 5-year survival rate of patients with lung adenocarcinoma and has become a milestone in the treatment of non-small cell lung cancer. However, to achieve precise targeted therapy requires determination of cancer cell mutations. The pathogenesis of malignant tumors is very complex and the treatment is also highly specialized. So, only certain hospitals (such as tertiary A hospitals) have relatively complete clinical treatment experience. Therefore, with the establishment of a precision medicine center, they can make full use of first-hand data to combine genome technology with the latest scientific research results of clinical medicine to provide references for disease diagnosis, treatment, and clinical decision-making.

Consortium/society aims to improve the changing standard system for genetic testing. Different types of genetic testing projects should have different finance policies. A diversified list of charges to maintain price stability and avoid large fluctuations is needed. By summarizing the experience of various medical institutions in the western Taiwan Strait in carrying out genetic testing pilots, the consortium can explore the establishment of financial subsidies and other genetic testing payment mechanisms. For example, in some areas where high birth defects have been occurring, public health service should provide free newborn screening to test for health disorders that aren't otherwise found at birth.

Consortium/society promotes the R&D and industrialization of genetic testing technology. Priority will be given to gene testing institutions to apply for financial science and technology projects. Support genetic testing institutions to introduce advanced technologies at home and abroad; carry out upstream and downstream businesses such as biochips, genetic testing instruments and consumables and reagents manufacturing, life science services, etc., expand new business formats; and cultivate growth points. Formulate and improve genetic testing data application specifications, promote genetic testing data information to enter the big data application platform of various departments, and realize the integrated development of genetic testing technology application and big data industry. Incorporate the provincial genetic testing technology application promotion demonstration center construction project into the provincial key project management, support genetic testing institutions to create provincial innovative leading enterprises, and open the provincial large-scale scientific instrument facility collaboration network to genetic testing institutions. Give key support to the first (set) of genetic testing technology-related equipment and the application of the first batch of products with independent intellectual property rights. Encourage qualified companies and institutions related to genetic testing to explore in accordance with laws and regulations in terms of operating models and application areas. Technical service platforms such as sequencing and information can serve more scientific researchers and the public, and can also attract more opportunities for cooperation.

Consortium/society needs a talent team. Implement the talent introduction policy and increase support for key projects. Any work cannot be carried out without talents, especially in the current situation, and the development of genetic testing technology requires good technical support. The operation of genetic testing and the improvement of sequencing accuracy can be improved through the improvement of operating procedures and technological advancement, but the implementation of these improvement measures ultimately requires human participation. Genetic testing is developing rapidly, but the bottleneck in data interpretation hinders its further development. Since most diseases are regulated by multiple genes and signaling pathways, genes in different tissues have different functions, and different types of gene mutations and different mutation sites will affect the phenotype and outcome of the disease. In the huge human genome database, about only 2% of the gene functions are known. In addition, the relationship between diseases and genes has not yet been clarified. It requires professional ability and complete knowledge system to correctly explain the relationship between genes and diseases. Therefore,

the training of talents and the recognition of qualifications are particularly important. This breakthrough requires the use of big data, artificial intelligence (AI), and other tools. Therefore, it is necessary to conduct professional training and training of relevant personnel from universities and scientific research institutions to strengthen scientific research on genomics-related technologies. Finally, cooperating with foreign companies and supporting R&D and industrialization of advanced genetic testing technologies will also be of great help.

Consortium/society can promote the high-quality output like publications and testing kits. The research characteristics of gene sequencing make it possible to obtain more results after the initial investment. Gene sequencing mainly relies on sequencing technology and data analysis tools, so a sequencing result can be a scientific research when analyzed completely. Therefore, completed data along with detailed clinical information and scientific research transformation can have very convincing results. High-level research publication, useful testing kit, and successful clinical trial can have an overall influence on research fields as well as public recognition with unique innovation ability, transformation ability, and unlimited development potential. Thus, a professional society for genetic testing and realizing regional management can solve the difficulties and problems in the construction and operation of genetic testing institutions in the Haixi economic zone.

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