Representative Yin Yulong: Integrating resources to establish a biomedical pig model R&D base

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"Scientists around the world use small animals such as mice and rats to carry out research, and have achieved some success in understanding disease mechanisms and other aspects, but a large number of clinical phase 2 and 3 failure cases tell us that the success rate of pharmacological experiments in small animals for clinical translational medicine is not ideal." At the 2023 National Conference being held in Beijing, Yin Yulong, a member of the National People's Congress, academician of the Chinese Academy of Engineering and chief researcher of the Institute of Subtropical Agricultural Ecology of the Chinese Academy of Sciences, suggested that resources be integrated to establish a biomedical pig model research and development base in Hunan.

Laboratory animals are basic, pioneering and strategic biological resources, and their level of scientific research and technological innovation profoundly affects the quality of life and health development.

Yin Yulong told the news reporter that pigs are similar to humans in anatomical size and structure, physiology, immunology and genome and have important application prospects in xenogeneic organ transplantation, vaccine and drug development. Compared to primates and other domestic animal models, pigs have advantages in various attributes, including short reproductive time, large litter size, and an easily editable genome. In recent years, pigs have become the animal of choice for human xenotransplantation. They have been applied in drug development research and toxicology testing to determine safe dose ranges.

According to incomplete statistics, about 2 million people worldwide need organ transplants yearly. In contrast, the number of organ donations

is far below the demand. In China, the ratio of those waiting for organ transplants to those receiving them is 30:1, and hundreds of thousands of patients die each year because they cannot wait for an organ transplant.

"The shortage of organ supply can be improved by xenotransplantation (such as transplanting organs from pigs to people)." According to Yin, there has been a history of transplanting pig heart valve xenografts to humans for over 50 years. Pig heart valves have been widely used in human clinics in China, the clinical application of pig corneas has been opened, and pig islet and skin xenografts have entered human clinical trials.

In 2020, the organ transplantation team of Xiangya Second Hospital of Central South University successfully performed the first allogeneic (pig-monkey) in situ total liver transplantation in China. The recipient monkey survived for more than 16 hours without immune intervention. Based on this, the team further improved the key core technology. It achieved a new record of 2-day survival for the recipient monkeys in November 2022. Professor Wang Wei's team at the Third Xiangya Hospital of Central South University has been exploring the use of porcine islet transplantation for the treatment of diabetes since 1995, screening for better donor pig strains, building the world's second medical grade (DPF) donor pig breeding centre in Changsha, and leading the development of the Changsha Declaration, a global programmatic document on xenotransplantation. In 2022, the team performed the world's first case of porcine islet transplantation after type II diabetic kidney transplantation. In 2022, the group performed the world's first islet transplantation after type II diabetic kidney transplantation. The

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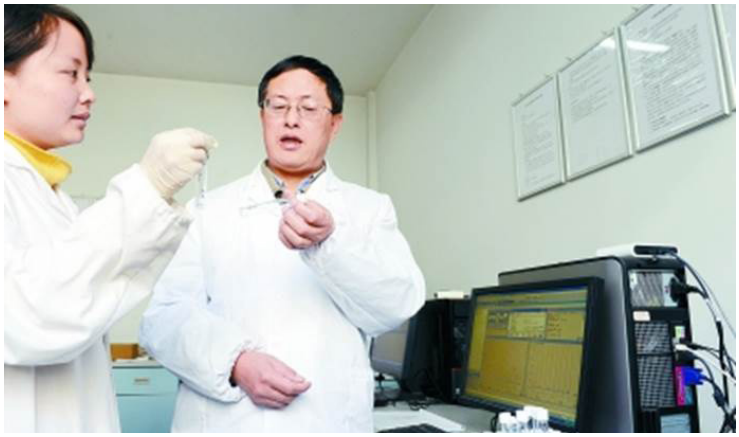
review results showed that the patient's indicators improved significantly.

Yin Yulong revealed that immune rejection is the biggest obstacle to xenogeneic organ transplantation. The team of experts in Hunan Province is actively researching gene-edited pigs based on the results mentioned above to reduce immune rejection and endogenous virus transmission in pigs and using gene editing technology to develop pig models of major human diseases to provide optimal carriers for drug and vaccine development.

"The main R&D bases of gene-edited pigs are located in Beijing, Yunnan, Sichuan and Guangdong, so experts in xenograft organ transplantation need to travel to multiple locations to complete the corresponding procedures, which greatly limits technology iteration and clinical promotion," Yin said there is a need to integrate the current superior research resources.

However, from a global perspective, the basic characteristic of China's pig industry is that it is big but needs to be stronger. It is leading enterprises and many retail farmers driving side by side. Leading enterprises play a relatively good demonstration role in applying new technologies. Still, retail farmers are not motivated to use new technologies due to their financial strength and ideological awareness. Rural revitalization firstly requires industrial renewal, and the long-term low-level disorderly competition among the scattered farmers in the vast rural areas is not only detrimental to the promotion of science and technology but also detrimental to the balanced and healthy development of the pig breeding industry and even to some extent will hinder the construction of a strong agricultural country. Therefore, free-range farmers urgently need a new organizational form to circumvent these unfavourable factors." Yin said.

On the one hand, free-range farmers' scientific and technological level is relatively low. The popularization of mature feeding technology is restricted by the "last mile", which makes it difficult to benefit the majority of small and medium-sized farmers; on the other hand, the blind expansion of pig farms in some places has led to an increasing disconnection between farming and cultivation. The material cycle of the farmland ecosystem is artificially cut, and the quality of arable land is degraded. In addition, influenced by various factors such as asymmetric supply and demand information, live pigs' market price has fluctuated drastically for many years. Small and medium-sized pig farmers need better anti-risk abilities and follow the farming trend, leading to large fluctuations in production scale and idle waste of small rural farmers' human, material and financial resources.



He has made great contributions to the efficient use of pig feed and healthy pig breeding. In the folk, he is affectionately known as the "academician of pig farming".

"The main responsibility of my research team and I is to improve the productivity level of pig industry through scientific and technological innovation, but the disorderly management and vicious competition in pig market also make us not to pay attention to the production relationship problem." Yin said that in the process of deepening the front line of pig production and operation, he and his team found that the "Trinity Integrated Cooperative" model of production, supply and marketing, and credit in the pig industry of Nanchuanhe Cooperative in Liuyang City, Hunan Province, might provide a good experience to break the shortcomings mentioned above of the pig industry's institutional mechanism.

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The "Trinity Integrated Cooperative" model is to establish a perfect information database on breeding enterprises, farmers, feed factories, veterinary medicine factories, breeding environment, the growth process of pigs, and breeding pig information so that government authorities and cooperatives can provide technical guidance, material supply, market control, financial and insurance services for production operators, and so on. The various business operations of the industrial chain support each other and avoid disorderly competition, which allows not only small farmers to fully share the value-added income of the whole industrial chain of pig raising but also serves as a bridge and link between the party committee and government and producers and consumers, which is not only applicable to the pig raising industry, but also suitable for the development of the whole agricultural and rural economy, and is the necessary way to build a strong agricultural country.

"It is recommended that the state support Hunan to build a provincial pilot of the pig digital breeding big data regulation and control platform, and further deepen the pilot to promote the 'Trinity Cooperative' pig farming model, innovate the production system, operation system and industrial system of China's pig industry, and promote the high-quality development of China's pig industry. " Yin said.

Yin Yulong suggested that the state build a biomedical pig model research and development base in Hunan Province to provide critical conditions to support the improvement of China's basic biomedical research level and the innovation capacity of the pharmaceutical industry.

Specifically, he suggested that the relevant departments increase the integration of funds to form a policy synergy to promote the biomedical pig model R & D base project and start construction as soon as possible.

"Experts from Hunan Province's 'Furong Laboratory' and 'Yuelu Mountain Laboratory' are working together to establish a biomedical pig model R&D platform to enhance the core competitiveness of China's pharmaceutical R&D. " Yin said he suggested that the state should support the construction of a biomedical pig model R&D base in Hunan to provide critical conditions to support the improvement of China's basic biomedical research level and pharmaceutical industry innovation capability.