PIONEERS IN PERSONALISED HEALTHCARE

Personalised healthcare is the goal of many biomedical studies seeking treatments and cures based on individuals' genetic makeup, lifestyle and the environment they live in. At Central South University (CSU), biomedical researchers are working on pharmacogenomics and building DNA resource banks, laying the groundwork for better precision medicine.

The integration of biomedicine and engineering, two traditional CSU strengths, has brought new research avenues to the century-old Xiangya School of Medicine at CSU. Xiangya Hospital, an affiliate of CSU, has applied new cloud computing technologies for gathering medical big data, and established a new model of information management for smart healthcare.

IMPROVING REPRODUCTIVE HEALTH

In 1981, soon after the world's first test-tube baby was born, China's first human sperm bank was established, led by Lu Guangxiu, a renowned in vitro fertilization (IVF) technology scientist. She now heads the world's largest assisted reproduction centre and the Institute of Reproduction and Stem Cell Engineering at CSU.

In 1983, China's first baby was born from frozen sperm at Lu's centre. In 1988, just months after the birth of China's first test-tube baby in Beijing, her team oversaw the birth of China's first baby from a donated embryo. Today, Lu's centre carries out nearly 50,000 IVF cycles a year, and has delivered nearly 140,000 babies.

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While helping infertile couples is part of Lu's goal, producing healthy babies and preventing transmission of heritable diseases are at the centre of her efforts. "My dream is to carry on my father's efforts in medical genetics to improve human health," said Lu, who is the daughter of Lu Huilin, a significant figure in the early days of medical genetics in China.

Lu has led her team in developing preimplantation genetic diagnosis (PGD) technologies for screening for genetic disorders. In 2015 they used PGD to screen embryos from a couple affected by hereditary cancer. Genetic testing of embryos led to a baby without the cancer-causing gene.

Lu's team also established the world's largest human embryonic stem cell (hESC) bank, providing resources for stem cell therapy and regenerative medicine. Using advanced freezing technologies, and IVF embryos, they have generated more than 500 hESC lines for tissue typing in regenerative medicine use. The hESCs are developed into differentiated cells, ranging from hepatic to neural cells, which have potential to be used in treating liver diseases, Parkinson's or diabetes.

Using the abnormal embryonic cells found via PGD, Lu's team has also built embryonic stem cell models of various diseases, providing an effective tool for studying disease pathogenesis.

"The future of medical care is to provide health services for the entire life cycle, and big data, coupled with AI technology will enable that," said Lu. Through an industry-university partnership establishing a healthcare group, Lu has integrated her reproductive hospital and stem cell institute to provide a chain of services. "We aim to provide quality, personalised healthcare to everyone," said Lu.

ENABLING PERSONALISED DRUG USE

People can have different responses to the same drug and dosage, given genetic variation, demographic profiles, lifestyles, and environments, underscoring the importance of personalised drug use. A CSU team led by Zhou Honghao, a member of the Chinese Academy of Engineering, was among the first to use rich experimental data to systematically prove differences in responses to drugs according to a patient's racial background.

Zhou's pharmacogenomics study, which investigates how genes affect a person's drug response, began with examination of drugs for high blood pressure, a leading cause of death in cardiovascular conditions. There are a variety of drugs to control blood pressure, but their effectiveness varies. Gene polymorphism, or the many forms of a DNA sequence, is a key factor explaining variations in drug response, and Zhou sought to clarify the genetic mechanisms underlying the variations.

After noticing that, in the 1980s, Europeans typically had a higher dosage requirement for a common antihypertension drug than Chinese, Zhou's study revealed the role of genetic variations of metabolizing enzymes in explaining the differences. His team further studied other popular antihypertension drugs, and identified their target genes, metabolizing enzyme genes and signalling pathways, revealing how the polymorphisms of these genes influence drug responses. They also indicated the superior effect of personalised therapy over conventional treatment.

Their work has led to the development of a genotyping chip that can be used to guide personalised drug use for hypertension patients. The chip just needs peripheral blood for testing DNA sequencing, which is highly applicable. This genetic testing kit was approved by CFDA in 2012 and is widely used in Chinese hospitals, having served hundreds of thousands of patients. Testing kits for other diseases are also being developed, covering conditions from hyperlipidaemia to cancer.

From basic research to product development and clinical use, Zhou's team has built a complete system for translational medicine. They have also established genetic testing technology demonstration site and training centre to train pharmacists and medical professionals about personalised medicine. "There's a lot to do to improve systems to better mobilize all the resources," said Zhou.

TRANSLATING MEDICAL RESEARCH TO PATIENT BENEFITS

Bringing research results from bench to bed is integral to work by CSU's biomedical researchers. Wang Wei from CSU's Third Xiangya Hospital is the first to gain government approval to conduct clinical trials for xenotransplantation using porcine pancreatic islets and islet cells, providing a potential solution to organ shortages for transplantation. His team has developed a pig breed with high islet yields and insufficient PERV-C genes, a virus that infects only pig cells and a risk factor in xenotransplantation. They have also established the technology for isolating and storing pig islets, and improved the surgical procedure in islet transplantation to ensure safety. Their technology has been used to treat type-1 diabetes, achieving good results, and improved biological safety.

Research at CSU on the genetic mechanism of lupus, an autoimmune disease that can lead to inflammation or organ damage, has informed treatment. Researchers have also made progress in genetic study of autism, and made a breakthrough in pinpointing target genes for nerve deafness.

CSU's Xiangya School of Medicine also houses three national clinical medical centres, on metabolic disorders, psychiatry, and geriatric disorders. Its three affiliated tertiary hospitals and a stomatological hospital serve people across the country, with outpatients exceeding eight million each year. Its medical professionals are also active in foreign medical aid, having performed cardiovascular surgeries around the world, sharing the Chinese experience with peers worldwide. ■

Distinguished alumni of Xiangya Medical College, Zhang Xiaoqian (top) and Tang Feifan, two of the three Chinese medical scientists ever celebrated on stamps.

Members of a CSU medical team to Sierra Leone provided treatment to Ebola patients.

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