转化医学研究（电子版）2011，1（1）：1-6
Translational Medicine Research (Electronic Edition), 2011, 1 (1): 1-6

Monograph



Zhi-nan Chen, *academician of Chinese Academy of Engineering; Expert of cancer biology and biotech drugs; Professor, Director and Doctoral tutor of Cell Engineering Research Centre & Department of Cell Biology, National Key Discipline of Cell Biology, the Fourth Military Medical University.*

Editorial note: *When you see the title of this article, you perhaps think that this article focuses on the future of translational medicine. You are right, however, in fact the article also talks quite a bit about the past and the present of translational medicine, e. g., who initially proposed the concept of translational medicine, what major events occurred since then, what impacts the translational medicine has produced on medical research, research and development of new drugs, and clinical practice. This article also pointed out what opportunities and challenges the world and China are facing in terms of translational medicine, and provides recommendations for how to take the opportunities and respond to the challenges, and thereby to make more and better medical techniques applicable clinically and for future development.*

The future and development of translational medicine

Zhi-nan Chen *

Fourth Military Medical University, Xi'an 710032, China

The modern medicine has been transformed into a new mode, stressing prediction, prevention, personalization, and participation. With health concept upgraded, a human being is considered healthy when he is free from both physical and psychological ailments. These novel and innovative perceptions of medical science in the 21st century has facilitated a convergence on the significance translational medicine.

In 2010, the total value of output in world pharmaceutical industry was 880 U. S. dollars, a pleasing indicator of an amazingly fast growth. In the sectors of biotech drugs and non-patent drugs (generic drug), the expansion was distinct, reaching 140 billion and 120 billion U. S. dollars. A synchronized progress was also achieved in Chinese pharmaceutical industry, with a total output value of 1200 billion Yuan in 2010. In the sector of the bio- and chemical medicine industry, this number has reached 106. 24 billion Yuan. The manufacturing of other health related products also increased by 15% annually.

In China, physical examination was used to be limited to such mandatory formalities as job applicant screening and army recruiting, and administrated exclusively by nonprofitable medical organizations. In the 21st century, people's health awareness was greatly enhanced due to the fast grown economy and the improvement of medical services, a direct indicator of which was the growing need for regular yearly physical examination. In fact, it has been included into the most organizations' welfare system for employees. This newly emerged demand oriented the development of a new segment of health industry. In 2007, the total output of health industry reached 25 billion to 30 billion Yuan, and is

* Correspondence: Zhi-nan Chen E-mail: znchen@yahoo.cn

estimated to be 1 trillion in 2020, with the output of physical examination business amounting to 100 billion to 200 billion Yuan. The industry of health products will create an output of 100 billion to 150 billion Yuan, and in particular, the nutrition industry for senior people will take the lead in the developing countries.

The global health consumption has assumed a yearly increase since 1990s due to economic development, life quality improvement, the increasing awareness of health service, and the growing need for health products. At present, the global market of health care is increasing by 8% annually, with 17% in Europe and 44% in Japan. The *Economic Daily* reported that the health foods have occupied 5% of the whole food market, producing an amazing output of 100 billion U. S. dollars, and continued to increase by 1% ~5% every year. The health food sales in the U. S. are 75 billion dollars at present and accounted for nearly 1/3 of the food market. In Japan, the sales volume attained 1500 billion Yen in recent two years. In Europe this volume is expanding by 17% every year. In China, the health food industry has bloomed thanks to the national policies for disease prevention, daily health care and nutrition balances, achieving an enormous sales volume of 200 billion Yuan in 2008. It is estimated that it will mount up to 450 billion Yuan in 2020.

The completion of the human genome project symbolized a leap of life sciences. New scientific and technological progress has sprouted in the areas of somatic cell cloning, stem cells, gene therapies, gene chip, transgenic animals and plants. The modern biology industry has also developed into a stage of large-scale manufacturing. The biopharmaceuticals sales has increased from 4% in 1995 to 15. 9% at present in the drug industry, among which the sales volume of antibody drugs was 46 billion U. S. dollars, vaccines 28. 9 billion dollars, GE drugs and products for cell therapy and gene therapy over 65 billion dollars. The acreage for GE crops attained 90 million hectares, raised 50 times as against ten years ago. About 80% of the 2000 developed biopharmaceuticals have been on the stage of clinical trials, and 6000 projects on transgenic animals and plants research have been approved. Meanwhile, such newly-emerging industries as bio-manufacturing, bio-fuel, bio-eco protection are rising.

The translational medicine, translational science or translational research was proposed in the 2003 NIH Roadmap for 21st century biomedical translational research by Dr. Zerhouni, the ex-director of NIH. A refined priority translational program framework was shaped after the discussion and evaluation of 300 experts from research institutions, enterprises and government. This framework emphasized the importance of converging scientific research and explored the approaches of effective coordination of research resources. It also called for the establishment of a more efficient and extensive administration system for medical research. The core is to promptly translate the preclinical research achievements into clinical practices, bridging the gap between Bench to Bedside (B2B), and Bench to Public (B2P). This translation is not a one way practice. The preclinical research will provide new therapeutic methods and drugs, and the clinical research will reward this offer by giving feedbacks to lab research. The translational medicine is hence known as the "actuator of the engine for clinical research". In 2010, the successive director Dr Collins moved further to integrate the translational medicine organization structure, and set up the NIH translational medicine and therapy center, which emphasized the core value of bridging the gap between the bed and the bench.

The NIH first proposed the idea of promoting medicine clinical practice by translational research. This innovative concept involves the worldwide coordination in clinical trials of new drugs, and in particular, the entire process of B2B and clinical application. The study of translational medicine has a remarkably favorable effect on not only the development of life sciences, but also on the development the industry and even the social stability. Therefore, it has become a novel interdisciplinary advocated by international medical community.

The value of translational medicine (in a wider sense Translational Science) has aroused a pronounced interest in European countries and the U. S., initiating their strategic acts. The U. S. has set up 60 translational medicine centers by integrating 824 research institutions, receiving an annual financial support of 500 million dollars from NIH. The UK has invested 450 million pounds into the translational medicine research, establishing the first coordination center for translational medicine research with a total investment of 50 million pounds. Four prestigious universities in UK (University of Aberdeen, university of Dundee, University of Edinburgh, and University of Glasgow), Wyeth Pharmaceuticals, Scottish Enterprise, and NHS have joined in this program. The EU has sponsored 6 billion Euros for translational medicine research. International core journals have started special columns for translational medicine research, and four specialized academic journals, *Science Translational Medicine*, *Journal of Translational Medicine*, *Translational Research*, and *Clinical Translational Science Journal*, were born.

The translational medicine has played an important role in the global pandemic diseases control in the past 15 years. The deaths caused by SARS were five times of the

casualties in the 911 terrorist attack. The H1N1 flu pandemic has aroused massive attention on the issue of public health, leading to the commitment into research on pathogens and the possible therapies. On the outbreak of pandemics, translational medicine can be materialized through a rapid procedure from BEM (bench, experience and microscopy) to another BEM (bedside, evidence and market) where data-based results from clinical practice will be turned back to lab for basic research. Lotus Qingwen Chongji, a Chinese traditional medicine for influenza, is a successful example of this procedure.

The development of translational medicine in China lagged behind the western world on the initial stage but gained a rapid growth in recent years. The Chinese Academy of Engineering and The Chinese Academy of Science have successively held the Strategic Symposium for Translational Medicine Development, and reached the consensus that the translational medicine could break the wall between basic research and clinical application whereas quickly translating the basic research outcomes into clinical diagnostics. The Ministry of Science and Technology, The Ministry of Health, and The Ministry of Education all attached importance to the development of translational medicine. Scientists have responded enthusiastically to participate in translational research and clinical practices. In this background, medical organizations specializing at translational medicine were set up by universities, academic institutions, and pharmaceutical enterprises, vigorously propelling the development of the translation of basic research. At present, *National Translational Medicine and Biotechnology Innovation Alliance* has been established, with Prof. Guowei Sang, the academician of CAE, as the honorary chairman and Prof. Zhinan Chen as the chairman. *The Northeastern China Clinical and Translational Medicine Center* was established at Harbin Medical University. The Second Military Medical University, Central South University, Shanghai Jiao Tong University, and Tongji University also set up their translational medicine centers. Peking University, Xiamen University and the General Hospital of PLA are engaging in the translational research and enthusiastically preparing for founding translational medicine institutions.

The 2nd Sino-US International Clinical and Translational Medicine Research Forum was held in June, 2011 in Shanghai. Delegates from both sides discussed the key issues in the translation of basic research into clinical research, including international cooperation in this field. This event was considered the highest rank academic communication in transitional medicine between China and US in recent years, establishing the milestone for Sino-US cooperation in clinical and translational medicine. The forum was hosted jointly by the Chinese Academy of Engineering, the Chinese Academy of Medical Sciences, NIH and Global MD, attended by medical doctors, preclinical researchers, medical administrators, and representatives from biopharmaceutical industry and NGO.

This forum was supported by the health ministries of both countries. Zhu Chen, the Chinese minister, made the opening remark, acknowledging the government financial and policy support for the translational medicine research. He reiterated the strategic significance of close coordination between China and US to enhance friendship between two counties and to make mutual contribution to the well being of human beings. The chairmen of the forum was Academician Shengli Yang, and co-chairmen were Academician Depei Liu, the director of the Chinese Academy of Medical Sciences, and Dr. John I. Gallin, the director of NIH. They introduced the current situation in preclinical research and clinical research in two counties and the most urgent problems to be solved. Their speeches indicated the general roadmap of clinical and translational medicine. This forum differentiated from the conventional conferences, stressing the interdisciplinary communication, bring up issues that both basic and clinical researchers were concerned.

The major problems in China's translational medicine research include limited interdisciplinary cooperation and resource integration, unbalanced infrastructure, low level translational achievements, and inadequate financial support. As early as in 1980s, the scientific institutions, enterprises, government and some social organizations have attempted to make joint efforts to integrate production and research, but due to the immature operating mechanism, they achieved unsatisfactory results, with a translational rate of mere 15%. Currently, translational medicine in China emphasizes unity, convergence, coordination and integration of scientific resources. In order to attain a better output, the academic research has been reoriented to the profound interdisciplinary coordination. However, more efforts need to be made in the integration of resources at all levels to propel the advances of biopharmaceutical industry, particularly in the areas of talents development, technology improvement, and financial fosterage.