Progression and prospects of translational medicine in China

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Translational medicine is a new discipline aiming to eliminate the barrier between preclinical and clinical medicine [1]. It converts promising laboratory discoveries into clinical applications and elucidates clinical questions with the use of benchwork, aiming to facilitate prediction, prevention, diagnosis, and treatment of diseases [2,3]. The Director of US National Institutes of Health (NIH), Dr. Francis Collins, proposed a new initiative of five thematic areas in 2010, and “Translating Basic Science Discoveries into New and Better Treatments” was one of those five thematic areas. Furthermore, NIH created its newest National Center for Advancing Translational Sciences (NCATS) on December 23, 2011. There is no doubt that advancing translational sciences have become an important mission of NIH. By leveraging findings from basic research, innovative methods and technologies as well as new targets can be developed for potential clinical applications of diagnostics and therapeutics in various diseases [3–7]. Although translational research has only relatively recently been formally declared a new discipline in 2003, it has existed much longer. In China, Professor Liu Shih-Hao [8] did develop his research, teaching and clinical work according to the fundamental principles of translational medicine in the first half of the 20th century. China bears a complex disease spectrum, thus the development of translational medicine will accelerate disease control and find solutions for health problems.

One of translational medicine’s aims is elucidating clinical questions thus facilitating diagnosis and treatment of diseases. In recent years, China has witnessed many important discoveries related to the research of translational medicine [9]. Some of the major themes touched by discoveries include research into mechanisms of diseases with the aim of identifying new therapeutic targets or improved therapeutic strategies. Prof. Yan [10] reported the role of T cells in skin inflammation, Shao and Qian [11,12] have investigated the mechanisms of infections, Profs. Wang and Li have investigated the role of Wnt/ β -catenin signaling in diseases [13,14]. Also researchers have made progress in elucidating mechanisms of development of tumorigenesis of lung cancer, breast cancer and colon cancer [13,15,16]. The most important role of translational medicine is converting promising laboratory discoveries into clinical applications. Translational medicine is a multidisciplinary program. In order to propel the development of translational medicine in China, Prof. Liu [17,18] proposed “9P-3P” medicine that would guide the development of translational research. There are some successful cases in translational medicine in chronic obstructive pulmonary disease (COPD) and cardiovascular diseases [19,20].

With the development of biotechnological technologies, we could explore the disease-relevant molecular information of each patient, and molecular targeted therapy has promising potential in treating diseases, especially in treating cancer [21]. Thus the next stage of translational medi-

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cine may focus on “precision medicine” in China. The precision medicine is coupling established clinical-pathological indexes with state-of-the-art molecular profiling to create diagnostic, prognostic, and therapeutic strategies precisely tailored to each patient’s requirements [22]. Precision medicine ensures that patients get the right treatment at the right dose at the right time, with minimum ill consequences and maximum efficacy.

What is the difficulty of translational medicine in China? First, the internal impetus of clinicians to scientific research is insufficient. Generally speaking, the motivator of scientific research should root in the questions raised in clinical aspects, accordingly the internal impetus ought to be the interest in searching for solutions to clinical questions. However, most of the clinicians have been doing research for promotion and keeping their jobs. For these purposes, the scientific research conducted by clinicians targets papers rather than science. Therefore, the most conventional mode is to get the most output from the least input. However, compared with clinical research, launching tracking and non-innovative basic research requires relatively less input and is at present easier to win project fundings in the grant application in China. Thus, a great number of clinicians are bustling with activities, participating in animal, cellular and molecular biological studies they are not interested in at all, and publishing a variety of so-called academic papers that would not be read even by themselves. This phenomenon results in two side effects: firstly, the scientific researchers’ budget resources in basic research are cut down seriously; secondly, scientific research activities without internal impetus but only directing toward survival have a tendency to generate academic dishonorable behaviors such as fabrication, falsification and plagiarism.

Clinical medical research lacks sufficient foundation in China. In the matters of surgical ability and clinical skills, Chinese clinicians are of first class in the world; as for humanitarianism and medical morality of curing diseases to save patients, they are no more than second-class; as regards the overall level of clinical medical research, they may be backward. Since translational medicine puts emphasis on clinical medicine and settles clinical queries mainly by fundamental research, how can the under-developed clinical medical research becomes the foregoer in translational medicine? There may be some dissenting voices, thinking there must be distinguished physicians who can balance clinical issues and scientific research. However, among the clinicians I am familiar with, those who are good at scientific research take up the study on medicine. Whether a clinician should do basic research is not discussed in this article, clinicians have a prominent part in discovering clinical questions, and make up the first-line troops for conducting clinical research in translational medicine. Translational medicine will come to nothing without the lead of the clinicians.

There is a shortage of achievements in basic research that

can be translated in China. The introduction of the concept ‘translational medicine’ is for the promotion of medical research; actually the importance of translational research in other related disciplines is clear to everyone. Take pharmaceutical research for example, which is also related to translational medicine. There are many organizations and institutions that are engaged in pharmacology, and large pharmaceutical enterprises have shaped their scales, but we have not pondered that how many drugs with real meta-innovation we possess. Hitherto a great deal of basic research is still following overseas trails on new drugs, while pharmaceutical enterprises mainly keep eyes on the production of low level generic drugs with low profit and no protection of intellectual property, or some other traditional Chinese medicine. There is a dearth of the most profitable drugs such as Viagra and statin, let alone Chinese drugs that can crack the world market. Definitely oriented by translation, pharmacology has such unsatisfactory performance, not to mention how many research achievements are of potential value in translational medicine in those research fields of basic biology—pathophysiology, physiology, biochemistry, biology, neurobiology, immunology—where translational medicine may be applied.

How to extricate ourselves from predicaments in China? Talent education is a focal point. The education of clinicians, especially those having a comprehensive grasp of basic and clinical research with multi-aspects of knowledge and skills, is the main part of translational medicine research. In the past, we had the ossified thinking for interdisciplinary education in medical-related disciplines, considering that those who are engaged in biological basic medicine research cannot manage clinical work, the deep-rooted reason for which is the lack of standardizations in the clinical skills education. In fact, everyone should be permitted to study medicine and apply it for medical licensing examination only if they want. Even if one has not attended normal classes in schools, he can also be qualified for clinician’s education so long as his theoretical and operative ability reach the standard, and after the completion of the required clinical practice, he can obtain physician qualification. Moreover, we should break off barriers between basic and clinical medicine to let clinicians bear a part in the scientific research and teaching of basic medicine, for example, surgeons can hold the post of anatomy professor, and pulmonary physicians can be the professor in the department of physiology and anesthetists should be allowed to take over as a professor of pharmacology, and teachers in subjects related to basic medicine can be encouraged to register for physician qualification, or directly involved in clinical activities, such as ward round and case discussion.

Strengthening clinical research is crucial. Most scientists in China had promoted studies focusing on clinical problems. Prof. Feng *et al.* [23] had studied the non-invasive detection of gastric cancers, and Prof. Niu *et al.* [24] had focused on identifying an indirect indicator of cartilage ma-

trix integrity and OA disease progression. Prof. Zhou and his colleagues [25] had investigated how to evaluate muscle fatigue to avoid occupational injuries. After all, translational medicine is intended to improve clinical outcomes; for either making the most of basic research achievements or solving clinical problems, or speeding up the study on diagnosis and treatment, clinical research is indispensable. Hence translational medicine is unable to get rid of the centrality of clinical research at any time.

Basic medical research should not be disregarded. The core of translational medicine lies in clinic, and the translational achievement and effect also depend on the level of basic research. Most basic research had shed light on clinical problems and focused on translational achievements. Prof. Zhang and his colleagues [26] had emerged in introducing computer-aided diagnosis in breast tumors. Prof. Chen *et al.* [27] had focused on illustrating how myostatin inhibits adipogenesis of porcine mesenchymal stem cells. Prof. Kong [28] had led to investigate the vaccine of HIV. Although these studies are basic research, scientists in China have made progress in translating the results of basic research to clinical application. However, the current predicament is that we raise the flag of translational medicine, but sadly, the reality shows the shortage in both clinical scientists working in translational medicine and fundamental research teams that help to solve difficulties in clinical medicine with high efficiency. Therefore, we cannot just be fond of its concept and be interested in increasing income by using translational medicine, but forget to exploit technological advantages in this campaign and ignore the construction of personnel and platforms that can tackle specific problems. At any rate, most of the existing centers for translational medicine seem to be too formalistic.

Based on international situation, on every account, there is a yawning chasm separating basic research and clinical application, and the disconnections among clinical demands, industry translation and technology application have become the barrier hindering the development of biomedicine. It is necessary to strengthen the combination of basic and clinical medicine, and promote the timely translation of clinical research in an industry-academy-research mode and eventually serve the patients. This is the most concise understanding and description of the necessity and importance of translational medicine. However, we have to think about it, specific to everyone, every school and every unit, can we bear this weight on our shoulders? Or does this imaginary chasm really exist? Preconditions for the existence of academic chasm is that basic and clinical research has already shaped as mountains, then the lack of bridge needs to be emphasized and the translation would be intensified. However, our problem seems to be that the levels of basic and clinical research are still as low as beaches, for which there is no value in translation. Their scales are not as large as mountains, so there is no canyon between them, and the stability and reliability of the 'translational medicine' bridge

established between two 'beaches' is worthy of reflection.

The importance of translational medicine certainly weights more than the above mentioned points, and to us, paying attention to this discipline may be of prospective and strategic significance. However, the weak foundation makes us have no idea how the eventual outcome would be. If we insist on building bridges between beaches, then the most important step is to lay a solid foundation and build sturdy piers not only on beaches, but also in the river valley, or we can take advantages of various advanced construction engineering technology to build cable-stayed bridges, girder bridges and so forth in order to realize the construction of translational bridges. Translational medicine is the modernest concept in medical research and has gradually filtered into people's mind, which will inevitably have an active impact on human medical research. Constantly, we should keep our enthusiasm, and keep asking ourselves why translate, what to translate and how to translate. Only by doing this can we not be lost in group psychology, lose our own directions and forget that working in a down-to-earth way is always the foundation.

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