Deepening the Reform of Higher Pharmaceutical Education for the 21st Century

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Pharmacy is a science that deals with the study of the functions of drugs interacting with human body and pathogens so as to prevent, diagnose and treat the diseases; to regulate the physiological mechanism of the human body; and to promote the human health. Therefore, the study of pharmacy should include the R&D, the production and the quality control as well as the distribution and clinical application of drugs. As an important part of the medical health-care studies, it plays a significant role in maintaining human reproduction and improving the quality of life, so that's why the development of the pharmaceutical industry has attracted the attention of governments of all countries. In the beginning of the twenty-first century, China will be able to change from “big country” to a “strong power” in the field of drug manufacturing with the further modernization of its pharmaceutical industry. In order to achieve our goals, we will carry out a series of strategies to further develop the pharmaceutical industry in China through the development of science and technology. Therefore, the further reform of China’s higher pharmaceutical education for the purpose of better meet the demand of the rapidly developing pharmaceutical sciences will be the urgent task facing the traditional form of pharmaceutical education in China.

DEVELOPMENT OF PHARMACEUTICAL SCIENCES POSES NEW REQUIREMENTS FOR PHARMACEUTICAL EDUCATION.

The pharmaceutical science has a long history. It emerged out from the human struggle against all kinds of diseases and has come to existence with the need to choose the required drugs against all diseases. The establishment of pharmacy has been based on the development of some related disciplines. Due to the limitations of all related subjects, chemistry used to be an essential subject for the study of pharmacy. We would always try our best to interpret the functions of drugs and to synthesize newly formulated drugs from the chemical point of view. During the past two decades, however, the rapid development of math, physics, computer technology and especially the development of biological sciences represented by molecular biology have made these sciences strongly felt in the course of the academic studies of pharmacy. We have been able to study the disease mechanism-related target of the actions of drugs at the molecular level.

Drug research enters the era of rational drug design based on the structure of the target compounds. Studies of almost all branches of the pharmaceutical sciences - drug design, novel drug development and drug mechanism, and even the production and application of drugs have had a chance to develop rapidly with the development of all branch disciplines, especially with the application of biotechnology. This new development trend calls an urgent need for all branch disciplines of pharmacy to coordinate with one another. For example, the mutual permeation of molecular biology, molecular pharmacology and medicinal chemistry helps to throw much light on the study of such targets of drug actions as enzymes, receptors and ion channels, which result in a revolution of the drug design theory. The overlapping and permeation of pharmaceutics, biopharmaceutics, pharmacokinetics, physical chemistry and material sciences promote the development of oral control-release, skin permeable absorption and target-administered drugs, making it possible for drugs to release at the fixed time, fixed amount and fixed place. Undoubtedly, none of the branch sciences of pharmacy can meet the requirements of the rapidly developing pharmaceutical science.

In the 1950s, the higher pharmaceutical education of

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China followed the European model and did not divide the specialities into many branches. Up to 1987, however, 16 specialities of pharmacy and pharmaceutical management had been established. All these specialities had their own curriculum system. It should be said that the disciplinary division of pharmacy met the demand of the medical and pharmaceutical sectors in China for a long period of time and contributed much to the development of the pharmaceutical industry. Unfortunately, with the development of the pharmaceutical sciences, the drawbacks of the present educational system became more and more obvious. The narrow division of specialities, the narrow spectrum of disciplinary knowledge and the weak foundation of the bases to a certain extent bound the overlapping and the inter-permeation of all disciplines and specialities. We have to adjust this so as to adapt to the development of all disciplines. The different situations are urging us to:

Define Specialities Rationally Under the Basic Law of the Disciplinary Development of Pharmacy

We should change our erroneous idea of establishing narrowly defined specialities so as to meet the demands of the changing society and the development of the rapidly changing disciplines. In the meantime, we should take a futuristic point of view in predicting the development of the pharmaceutical sciences in the twenty-first century.

Widen the Scope of the Specialities to Meet the Needs of the Society

Major courses for the undergraduates of pharmaceutical sciences should be math, physics, computer, chemistry, life sciences and basic medical sciences, and those courses related to the production, inspection, distribution, management and safety and rationality in drug use, etc. We should work out a suitable curriculum so as to encourage students to study basic theories, basic knowledge and basic skills, and also to cultivate the basic qualities of the students and their adaptability to the rapid development of new disciplines.

THE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY POSES NEW REQUIREMENTS FOR THE CULTIVATION OF PHARMACEUTICAL TALENTS

The rapid development of the pharmaceutical industry and the quick transformation of the system of the pharmaceutical economy put forward new requirements for the level and quality of the pharmaceutical talents. On one hand, the strategic transfer from imitation to creation sets higher demands for the R&D of new drugs. On the other, pharmacy has a bigger area and wider range of service. It involves the production, operation, management as well as the rational and safe use of drugs. When establishing the objectives of higher pharmaceutical education in the past, we positioned the cultivation of undergraduates at too high a level, wishing to cultivate our four-year undergraduates into high-level specialized talents. This resulted in the heavy load of courses for the students who otherwise could have and should have had more initiative in their studies rather than more examinations to take. In the new century, the cultivation of pharmaceutical talents should be directed towards the following two orientations. First, we should try to cultivate high-level talents for basic pharmaceutical research and novel drug development through the combination of both undergraduate and postgraduate education. Second, we should try to cultivate talents for professional social services in the fields of the production, distribution and clinical drug administration.

Cultivating High-Level Talents for Basic Pharmaceutical Research and Novel Drug Development

The development of modern pharmaceutical sciences calls for an urgent need to cultivate specialists in the fields of basic pharmaceutical research and novel drug development. They should have a good basic knowledge of various disciplines, a broad knowledge of their speciality and a strong creative ability. Four-year undergraduate study is far from enough, so we need to construct new models to cultivate pharmaceutical talents. For example, we can set up special intensive programs or implement special high-level cultivation plans for those outstanding students. Those who don’t meet the high-level cultivation requirements can be transferred to some other specialities. Excellent students can be recommended to further their study as MS candidates without examinations. Since 1994, China Pharmaceutical University and Nanjing University have been running a cooperative intensive program of Biotechnological Pharmaceutics, which has been an effective and active trial in cultivating talents of pharmaceutical researches. Students in the program have high intelligence, broad knowledge as well as good qualities. With the solid basis they have developed in Nanjing University, they then receive some special training at China Pharmaceutical University. Therefore, they have a very strong base of both basic knowledge and special expertise of pharmacy after the joint-effort cultivation of China Pharmaceutical University and Nanjing University. Now, 60 percent of the students in the class are studying for their master’s degrees in many key universities in China. We are pleased with our preliminary success in cultivating high quality talents for basic pharmaceutical research and novel drug development.

In 1996, China Pharmaceutical University was approved to set up a base for scientific studies in cultivating talents in basic pharmaceutical sciences. On the basis of the sound analysis of the knowledge, the competence and the make-up of the students in the “Science Study Base” program, we stipulated some special measures. We adopted the basic principle of “strengthening the basis, broadening the students’ knowledge spectrum, allowing students to transfer to other specialities in the more-than-one choices of research fields.” China Pharmaceutical University tries its efforts to stimulate the students’ sense of academic research, improve their understanding of science and train their basic ability to undertake research work for the purpose of improving the comprehensive quality of the students. China Pharmaceutical University has successfully combined the construction of the national scientific base with the cultivation of high-level talents for pharmaceutical researches.

Cultivating Talents for Professional Social Services

There can be three types of these professional talents (also called practical pharmaceutical practitioners): (1) Engineer-type technical talents: They are supposed to be able to solve the technological problems in the R&D and production of drugs. (2) Pharmacist-type academic professionals: They can solve those practical problems of quality control and rational and safe application of drugs. (3) Manager-type talents: They can solve the problems in the areas of scientific decision-making, organizational coordination and business management. Under the market-oriented economy, there are many channels towards employment with high level of unpredictability, so these students should have a solid professional basis, a broad spectrum of social services.
of academic knowledge, a strong ability to analyze and solve problems and also an ability to gain knowledge through their own efforts.

In the cultivation of these professional talents, field practices should play a significant part. Students should be arranged to visit factories, hospitals and drug inspection institutions so that they can enrich their knowledge, increase their capability and improve their ability to work independently. Most of these talents will choose to find a job after undergraduate study, so enough attention should be paid to the relationship between the teaching of theories and practices in the curriculum designing, making sure that the students know how to put what they have learned into their practical work. Engineer-type technical talents should spend more time on such courses as industrial automation, designing of pharmaceutical workshops and facilities, and GMP, etc. Pharmacist-type academic professionals should optimize the various courses of pharmacy and be concentrated on such courses in basic medicine as pathological physiology, clinical pharmacology, clinical pharmacokinetics and toxicology. Manager-type talents should learn more management courses aside from the basic courses of pharmacy.

**PERSPECTIVES OF THE REFORM OF HIGHER PHARMACEUTICAL EDUCATION FOR THE NEW CENTURY**

**Optimize the Curriculum System of Pharmacy-Related Courses**

In this new curriculum system of pharmacy-related courses, basic principles should be emphasized in designing the basic courses. Some necessary macro-combination and macro-adjustment work should be undertaken over the pharmacy-related courses so as to break through the traditional framework of curriculum designing on the basis of only one second-grade discipline. Efforts should be made to eliminate the narrow division of special courses. Instead, we should emphasize the mutual association and coordination among different courses. We hope for better structural balance and flexibility through the overall optimization of the curriculum system. Priorities should be given to basic chemistry lab skills, life science courses, pharmacy-related basic medical sciences and computer and foreign language studies over the antiquated experiments and unwanted redundancies in the original teaching materials.

**Enhance All-Round Quality of the Students**

In the education of undergraduates of pharmacy-related specialities, special attention should be paid to the enhancement of the all-round quality of the students through the organic combination of quality education and ability improvement, incorporating quality education to the education of their specialities. While students are spending a lot of time to study the basic what-is-what, they should be encouraged to develop their creativity through the systematic studies of various courses. Priority should be given to the cultivation of the practical ability of the students on the basis of their theoretical knowledge. Lab work should be an important and direct way to improve their practical ability. Through the lab experiments, the students can learn how to put what they have learned in the classrooms into practical application. They are also encouraged to participate in all kinds of social activities so as to learn more about the society, which is a good way to cultivate the students’ sense of serving the society.

While trying to improve the general level of the existing specialities, we should never forget to try by every possible means to develop the potential ability of students to become real talents through their own efforts. Through the establishment of courses in humanities, management and economics, we expect to permeate liberal arts into the sciences. In this way, pharmacy-related students can have a chance to enhance their sense of self-improvement and that they can learn more ways of making themselves become the real talents that are required by the society through their individual struggles.

The prerequisite to the improvement of the students’ all-round quality is to have a highly qualified faculty. It requires that teachers, besides high level academic degrees, should also have good academic qualities. Faculties in the field of pharmaceutical education should be aware of the development trend of the pharmaceutical sciences. They should be able to hold a forward position in the latest developments of pharmaceutical sciences so that they can tell the students where to go and what to do, stimulating the students’ aspiration for more knowledge and teaching them new ways of learning. In a word, teachers are playing a critical role in the cultivation of high quality students.

**Undergraduate Education Should Lay a Solid Basis for their Life-Long Professional Practice and Academic Education**

The rapid development of the pharmaceutical sciences, the exploding increase of medical and pharmaceutical information and the ever-increasing varieties of new drugs and new medical approaches have made pharmacy more and more a profession that is based on a non-stop learning process. Pharmaceutical education should be conducted on the basis of the “school education – post-graduation practices – continuous education” model, making students aware of the importance of life-long education.

We have now entered the new millenium and will undergo unprecedented changes that are basically characterized by the internationalization and the explosion of knowledge and information. Medical health-care and the pharmaceutical industry will play a more and more important role in the national economy, thus inevitably setting brand-new requirements on the knowledge and competence of the pharmaceutical talents. Therefore, a heavy burden over the shoulders of the higher pharmaceutical education institutions is to deepen the reform of the pharmaceutical education. In this way, we can cultivate more high quality talents with strong adaptability and sense of innovation and can thus further contribute to the development of pharmaceutical research and pharmaceutical industry in China.

*Translated by Shi Zhixiang*