

Principles of Vocational Training of Highly Skilled Specialists of the New Generation

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Mini Review

Volume 1 Issue 1

Received Date: November 23, 2018

Published Date: December 21, 2018

Abstract

The fundamental, modern training of future medical staff requires an introduction of the new principles of global higher education practice into current Russian medical Universities. Modernization and integration of widely-accepted medical and teaching standards requires consolidation of both the natural sciences (fundamental sciences) and medical sciences (applied and clinical) that may become the conceptual basis for a University medical education. By virtue of the novelty of this field, we must not only improve, but significantly change the current system of training for medical staff. The main goal of this training is not simply to achieve advanced training and expansion of technological skills, but to provide development of novel multifaceted approaches to “build” academic schools for future generations.

Keywords: Supplementary Education; Biomedical Classes; PPM; Hi-Tech; Mentor-Mentee Tandem

Abbreviations: NGS: Next-Generation Sequencing; EPMA: European Association for Predictive, Preventive and Personalized Medicine.

Introduction

Current Incredibly rapid progress in science and technology calls into question the existing educational model because this model does not provide us with fundamental knowledge, a very important component

part of standards that are being established in economy and, accordingly, in education of the 21st century. Need for the integrated system of primary, secondary and higher education has proved obvious prompting us to search for new ways capable of launching the educational system onto a higher level and making positive shifts irreversible.

More and more countries today are stressing their national goal to establish a continuous and intensive system of education throughout life consciously. Such

customization of educational process provides additional and/or supplementary education, assisting the children to build their own pathway to learn and to know, whilst disclosing their own talents. Student-targeted and person-centered education provides additional development of the child in the direction of his own dream whilst securing the child more desired rather than mandatory, and creating a situation at a risk of success with a steady growth of motivation for cognitive activity. Thus, integration of the primary and secondary education as a set of the pre-agreed conditions provides:

- Development in the chosen direction.
- Optimization of the jointly set activity of a student and the teacher within a PAIR or a TANDEM (mentor-mentee)-every teacher must interact with each child in developmentally and culturally appropriate ways, whilst also meeting the standards. The need for teachers to be competent in all areas of professional practice has never been greater.
- To optimize the load due to customize education.

A particular interest should be attributed to a point of starting of a process of education to enrich a mentee's portfolio with a set of Hi-Tech experience whilst having the mentee trained at famous research centers and within the university facilities! That means that a multistep procedure of forming a competent specialist should not be restricted by the post-university internship training, but be broadened at a pre-university (secondary school) stage, in other words, simultaneously with the profiling seminars and workshops to secure the positive mental motion. Choosing the correct pre-university (school-based) program and school, in particular, is of the utmost importance for the future of the education and the professional career. So, there is a need now to guide school administrators, faculty mentors, and political leaders in making intelligent decisions when planning pre-university school and college programs. Meanwhile, building the necessary skills for modern medical school requires developing a strong foundation in the sciences.

PPM as basis for New Model of Health Care

In the late 1970s the global audience witnessed such an extraordinary breakthrough in fundamental sciences that the mid-1990s forced us to systematize accumulated knowledge and elaborate procedures how to implement it. Such model of innovative development and the relevant model of education allow to form the very specialist having the necessary scope of competence required, firstly, and, secondly, acquiring interdisciplinary competence thus forming not a primitive physician but a specialist who using routine medical standards with

creative elements could render highly skilled personalized assistance to patients.

Based on current trends and own experience, we have made the first steps to creating the educational tandem "School-University" and to organizing classes specialized biomedical at school where students are aimed at the participation in health care modernization.

Today's education is more focused on disease but in our complex world of health care and securing the health stability, there is a growing need to focus more on health maintenance. So, the long asymptomatic period before the onset of chronic diseases offers an opportunity for disease prevention. Many chronic diseases may be prevented by avoiding those factors that trigger the disease process (primary prevention) or by use of therapy that modulates the disease process before the onset of clinical symptoms (secondary prevention). Prediction is important for disease prevention so that preemptive treatment can be given to those individuals who are most likely to develop the disease. The theoretical base of PPM includes the use of genomics, proteomics, metabolomics and bioinformatics, which are basic algorithms. These algorithms are principally different from traditional clinical approaches by introducing the use of multimodal consultative and diagnostic centers for more efficacious measures of PPM. So, all health professionals in PPM as a modern model of healthcare services and related fields should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidence-based practice, quality improvement approaches, and bioinformatics.

The training of specialist who capable to building the interdisciplinary structure of health protection will be based on the new generation principles, taking into consideration the following:

- Peculiarities of introduction of school-university partnership onto international educational ground.
- Role of extra-classes education as the basis for such ground.
- Project principles in the framework of extra-classes education and design of research and engineering games.
- Tough necessity of multi-level testing and dialogues in the partnership student-teacher, their personal features considered, while forming vocationally self-sufficient, promising and highly-skilled specialist with personality for the future.
- Importance of innovation-related risks of educational process and possibility to manage those risks in crises.

The above model should contain the following:

- Education-method nucleus, which is represented by a three-level system of fundamental education (pre-university, undergraduate and postgraduate).
- Key platforms of fundamental knowledge and skills.
- System of group and private vectors showing priority lines and essence potential of intensive and qualitative improvement of knowledge.

The Team of Young Researchers

Non-canonical approach has been used to create a team of young researchers and clinicians which has been recognized as International Research Team of Youngsters rooted from a variety of universities and given a roof under the aegis of European Association of Predictive, Preventive and Personalized Medicine (EPMA), Brussels, EU. The major feature of the team is that apart from having medical students and young clinicians joined the team and coming from a variety of universities, there are also non-medical students and schoolchildren, who have demonstrated an interest for Hi-Tech areas of modern medicine.

The Team has actively originated in organizing and performing National and International Conferences on breakthrough technologies, including 2011 Saint Petersburg the First International Congress "Molecular Basis of Clinical Medicine" and First EPMA Congress (Bonn, Germany). In 2012, at the University of Lancaster (Lancaster, UK) the first British-Russian Workshop for Youngsters on Translational Medicine has been organized by EPMA-SYP Group and International Research Team of Youngsters. The Team has attended to the European Congress of Immunology which was held in Glasgow, UK. The global event for 2013 was held at the European Parliament in Brussels, Second EPMA Congress to have presentations made by young professionals covering a range of ages from 14 through 25 (schoolchildren pre-graduate, graduate and postgraduate students, PhD students, interns, and young clinicians and researchers).

The Program of Elective Courses

Under the guidance of Professor Sergey Suchkov, (Department of Pathology, I.M. Sechenov, The First Moscow State Medical University, Russia), who is a member of the supervisory board of EPMA (European Association of PPM, Brussels, Belgium), a group of undergraduates, postgraduates and interns from I.M. Sechenov, Moscow State Medical and Dental University developed a program of elective courses for senior students. That activity was supported by a number of

prominent scientific centers, such as the Russian Academy of Sciences and Academy of Medical Sciences, and included high-tech disciplines such as genomics, proteomics, metabolomics, bioinformatics. The elective courses cover the most important issues of practical health care, including chronic diseases of autoimmune and infectious nature, different forms of congenital diseases and malignant diseases.

Through the program not only university students but also individual schoolchildren have initiated their own research (in the evening and night time) as a supplementary educational addendum at a variety of labs of the research centers, universities and affiliated facilities to get training courses in the areas of Hi-Tech including genomic and post-genomic technologies. Apart from a practical segment of the Training Programs, we have organized at School N204 a series of presentations made by famous researchers including Prof. Aldo Scarpa, Italy; Prof. Trevor Marshall, USA; Prof. van Gent, The Netherlands and Prof. Hiroyuki Abe, Japan.

All of those efforts were supported not only by the teaching personnel (mentors) but by the schoolchildren (mentees) to get their dreams alive. We think that the experience accumulated would open a green light for getting it implemented into practice, and later, extrapolate it into the frame of modern standards of international educational platforms.

Currently, a new educational program is being developed on the basis of the Sechenov First Moscow State Medical University, aimed at training doctors and specialists in the field of biopharmaceutical industry. Within the program it is planned to train specialists for medical, pediatric and bioengineering faculties. The courses of the program are divided into three categories - basic, elective and specialized. At the first stage of pre-university training, general aspects of human physiology and anatomy, the foundations of molecular and cell biology will be considered, and also students will learn the basics of PPM. The program of higher education will be divided into three stages. The first includes the first two courses, in which students will study the fundamental foundations of PPM (Omics, Genetic Engineering, Genomic Editing and Gene Therapy, Immunology, Biomarkers, Bioinformatics, Targeting, Technologies for Working with Proteins and Genes, Biobanks). Further, at the stage of the three-year university education will be the study of diagnostic, preventive and therapeutic diagnostic platforms of target categories of PPM, among them pharmacogenomics, oncology, pulmonology, pediatrics and others. At the next one-year training stage, students

will study clinical and preclinical models with predictive-diagnostic and preventive-preventive orientation, risks, their evaluation and the formation of diagnostic protocols. At the postgraduate stage students will study preclinical and clinical trials using the biobank base, a pro-gram for managing one's own health, including family planning, the stage of genomic scanning and clinical evaluation, clinical bioinformatics, as well as interdisciplinary aspects, including bioethics, the basis of public-private partnerships in modeling personalized and preventive medicine and questions of sociology.

In the training programs will include the tasks of training the students and planting skills in the following fields:

- Understanding of the key molecular mechanisms of disease development and designing models of pathophysiologic mechanisms of the latter with preliminary selection of potential pPTT.
- Identification of basic structural-functional shifts in the physiological architectonics of cell biomolecules causing generation of cell pathology, pathology of intercellular interactions and, as a result, the overall pattern of clinical symptomatics.
- Screening of biomarkers necessary for use in predictive diagnostics, prognostication and monitoring of diseases at the preclinical and clinical stages of dis-ease.
- Understanding of the principles of modern diagnostics, analysis and interpretation of laboratory data permitting to perform identification of key cellular shifts when various pathologies are formed.
- Use of molecular targets with the aim of prophylactics and prevention of dis-ease at the clinical stage or typical pathological process at preclinical stage.

A graduate of specialized courses should know the following:

- Theoretical and methodological basis of the fundamental medicine corresponding to the contemporary level of world knowledge in the field of systems biology and fundamental biomedicine.
- Principles of designing of a model of pathological process with identification of biomarkers and selection of targets necessary for effective control of pathological process.
- Pool of modern technologies used to improve the effectiveness of the analytical cascade including with the use of interdisciplinary approaches and modernization of the integrated infrastructure of biopharmindustry.

An important part of program is the creation and development of fundamentally new technological

platforms with elements the commercialization of the results of basic research and following introduction of them into clinical practice. For example, the development of innovative methods system of screening and monitoring will allow estimating the reserves of health, allocate among the asymptomatic contingent in the process of preventive examinations of patients and persons from risk groups with preclinical stages, and create objective pre-requisites for personalized therapy. And the creation of an information system for personalized medicine prescribes the development of a new model of the patient and people at risk with using biomarkers, preclinical and predictive di-agnostics technologies, and the development of new methods for targeting and motivating healthy lifestyles and active longevity. The key to implementing PPM in clinical practice is information technologies, including machine learning and artificial intelligence.

Such a faculty's lectures and practical courses will touch upon all aspects of next generation MPs and PDTs modelling and processing (at different stages and levels of the creation process), as well as elements involving the forecasting of their respective market segments. Being involved with a student's development is of particular importance, as they should be familiarised with the principles and methods of validating the final product, the procedures for market calculations, and the prospective applications of a product in clinical practice. The specialist of the future will also have the ability to pursue follow-up research to enhance the product itself and widen the scope of its application (repurposing), and this will all be achieved with the aid of cutting edge equipment.

Special attention will be delegated to school-based (Pre-University) courses including: Next-Generation Sequencing (NGS) and related technologies; mass-spectrometry and proteomics; immunoassay platforms and techniques; bioinformatics-related network technologies.

A programme is being created for the purpose of training specialist bioengineers in the fields of genetic-engineering and genome editing technologies, biotechnology, clinical pharmacology, biomedicine and biomedical application of nanotechnology. This programme should be a mandatory component of every pharmaceutical designer's and bioengineer's training in specialized Russian higher education establishments which possess the relevant human resources and bioengineering infrastructure to accommodate it.

Thereafter the curriculum for training of physicians at the premises of University will be developed, the aim of which is to acquire general professional and specific professional competencies to provide on-going medical assistance to each applicant - patient or person at risk, (regardless age, sex and character of disease); for the implementation of patient care, taking into account family history, the society in which he lives, its culture, ensuring respect for the principle of personality's individuality.

The programme focuses on familiarising bachelors, masters and Ph.D. students with scientific research, applied production as well as managerial and pedagogical activities. These assets are then implemented in the creation of a cluster (unifying I.M Sechenov First MSMU with a number of specialist higher education establishments) which provides:

- Unity between scientific, educational/pedagogical, production, and monitoring/oversight processes;
- The continuation of the educational process within flexible international platforms, and the interrelation of these platforms and programmes within a single cluster;
- Innovative focus on the academic and applied sections of the educational process before the transition into practices involving advanced technologies;
- A programme involving constant consumer marketing and calculations of potential, actual and projected market segments, which function as a practice model for the training of biopharmaceutical industry's future entrepreneurs/executives.

To secure the positive outcome of the reforms we are planning to take several steps.

- Globally, to focus on the importance of/new generation disciplines whilst better incorporating omics-technologies and bioinformatics into the Curricula so that students understand the underlying science and its application to Targeted Medicines and Predictive Diagnostics tools.
- To provide at regular schools fellowships in Fundamental Medicine and Pharmacy-related Biomedical Areas, which would help to establish the field as a subspecialty.
- To actively engage at regular schools in developing new standards of health care to integrate new targeted therapeutics, personalized and predictive tests, and quality standards for testing.

Final Remarks

In practice of dealing with gifted children, innovative technologies play a special and extraordinary role, contributing so much to building the creative potential of the child targeting their promising dreams. Outcome of this activity within cohorts of gifted mentees may be used in the educational process further, and may be pre-selected by us as bricks for getting the results of the designing activities in student- schoolchild pairs or postgraduate student-graduate student-schoolchild trios.

The above-mentioned course of training is aimed at forming new scientific understanding to allow development of new diagnostic and therapeutic/preventive tools for subclinical diagnosis and pharmacoprevention.

