

CORRESPONDENCE

New developments in medical education for the realization of next-generation personalized medicine: concept and design of a medical education and training program through the genomic cohort study

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The realization of personalized medicine is the greatest medical challenge of the 21st century. Through highly effective preventive medicine programs, the application of personalized medicine to preventive medicine (personalized preventive medicine) in particular is expected to contribute significantly to the resolution of problems such as reducing the incidence of disease and facilitating effective, efficient use of social security funds in rapidly aging societies.

Expectations for personalized medicine have recently intensified due to the Human Genome Project, which has unveiled virtually the entire base sequence of the human genome.^{1,2} However, decoding the genome sequence alone is not useful for promoting healthcare. Personalized medicine can be offered to the public only after risk genes for diseases have been identified in large genomic cohort studies in healthy subjects, and drug development research, as well as preventive and therapeutic applied research, has been conducted. Because genomic cohort studies are applicable to a wide range of diseases, including lifestyle-related disorders, they are essential for the realization of personalized medicine, especially personalized preventive medicine.^{3,4}

Now, then, is the moment for various fields, such as molecular epidemiology, clinical medicine, public health, genetics, statistics, medical sociology and molecular biology, to collaborate organically toward the goal of realizing personalized medicine. However, very few leaders in these fields are capable of supervising basic research to practical application, and this is what is blocking the road to practical application.

Because genomic cohort studies and the realization of personalized medicine require organic collaboration across a multitude of fields, the problem is considerably more serious than in other areas of study. For instance, the importance of genomic cohort studies as an essential step in the realization of personalized medicine is not fully recognized by many clinicians, as well as epidemiologists, genome researchers and public health-related researchers, making it extremely difficult for these researchers to collaborate organically. Under such circumstances, we will undeniably face difficulties at the application and implementation stages of the realization process.

The most effective way to solve this problem is to systematically understand how to collaborate organically among different medical fields (clinical medicine, public health, genetics, statistics, medical sociology (including medical economics, medical informatics and medical product evaluations) and molecular biology) in order to realize personalized medicine, and to continuously train and educate medical professionals, young researchers and students who can guide the entire discipline. In this way, leaders of the personalized medicine era will be produced, and specialists with the ability to lead in a number of related fields (clinical practice, public health, medical administration, medical research and drug development research) will also be fostered. Only after this will it be possible to effectively conduct a range of studies from basic research to societal contribution, and subsequently to aid in improving national health. Fostering such talented leaders can only be accomplished

through training in supervisory skills and by understanding the entire discipline from the perspective of both theoretical and practical systematic education. Achieving this solely through so-called ‘classroom’ education would be difficult.

By conducting the Medical Education and Training Program through the Genomic Cohort Study, we, as the Faculty of Medicine at this institution, through the educational programs that we provide and the promotion of personalized medicine in Japan, not only aim to maintain and promote national health in the 21st century, but also to solve the various problems faced by our healthcare system, including increased social security costs.

Table 1 shows the plan of the Medical Education and Training Program through the Genomic Cohort Study. The strongest feature of this program is that both theoretical and practical education in the field of high-quality genomic cohort study is feasible. It is important for future trainees to thoroughly understand the fundamentals of large-scale genomic cohorts from both theoretical and practical perspectives in order to realize personalized medicine. At Yamagata University Faculty of Medicine, the Advanced Molecular Epidemiology Research Institute founded by the Global COE (Center of Excellence) Program is at the core of establishing a Yamagata Prefecture-wide genomic cohort study field.⁵ In addition, mathematical and genomic statistics specialists, who are few in number in Japan, are also a part of the Advanced Molecular Epidemiology Research Institute.⁶ If these fundamentals are effectively utilized in education through this program, a

Table 1 Project outline**Education***Faculty-led classes for high school students*

University faculty are dispatched to give classes at high schools that differ from everyday instruction. These classes are designed to encourage students to take an interest in medicine and science before deciding which subject to do at university. Class content does not just focus on personalized medicine and genome medicine, but may also broach topics beyond those outlined on these pages. Class content may be tailored to the interests and needs of teachers and students.

Introduction of new lectures and seminars (undergraduate level)

Curricula have been amended and updated in order to deepen the understanding of personalized medicine and genome science, the discipline at its core, among young medical students, who will be the driving force of medicine in Japan in the future.

Genomic cohort study course (graduate level)

In addition to the goal of improving public health, the promotion of personalized medicine is important from a practical perspective too, specifically efficiency in social security spending. This requires effective collaboration and partnership among diverse fields, including clinical medicine, public health studies, epidemiology, molecular biology, genetics and statistics, in order to ensure that the findings of basic research projects—as exemplified by genomic cohort studies—are translated into solutions that will make a meaningful contribution to society. There is, however, currently a critical lack of people capable of taking an overview that encompasses multiple disciplines and driving project results to practical application. As a result, the task of training such people is extremely urgent.

This course is open to graduate students of all specializations. The course will attempt to provide students with a broad-ranging and systematic educational program that examines the entire process, from genomic cohort studies to exit strategies. We hope it will be attended by graduate students eager to get involved in the next generation of medical studies and medical care.

Genomic cohort training program (short-term trainee intake program)

This short-term intake program is offered to other educational institutions that are not able to provide students and researchers with opportunities to undertake practical training as part of an on-going genomic cohort study. The training comprises seminars on genomic cohort study theory, together with practical work such as conducting baseline studies within the Yamagata Molecular Epidemiological Cohort Study. It is designed to provide trainees with both strong theoretical understanding and useful practical experience.

The program is open to persons involved with medical care, researchers, graduate students and any other persons who would like to apply.

Genome medical research coordinator (GMRC) training course for professional training and development

GMRCs are responsible for conducting genomic epidemiological studies; this course is designed to provide specialist training. It covers all the knowledge and skills required to obtain a GMRC license authorized by the Japan Society of Human Genetics.

We also offer other programs, including training programs for clinical geneticists, accredited clinical cytogeneticists and clinical genetics counsellors. E-learning courses open to working professionals are also available.

Research training

Young researchers (post doctoral fellows) working in fields relevant to the realization of personalized medicine (genome epidemiology, genome analysis, genetic statistics, mathematical statistics, medical sociology, translational research, etc.) are appointed as tenured faculty and provide support to research projects making use of or related to the genomic cohort field.

This allows us to train young researchers with the necessary expertise.

Public awareness*Public lectures and symposia*

The program also holds symposia and public lectures, open to the general public, in order to encourage those members of the public resident in Yamagata prefecture who are cooperating in the Yamagata Molecular Epidemiological Cohort Study to enjoy as healthy as lifestyle as possible. Health workshops designed to encourage and improve everyday health management are run, as well as lectures intended to introduce personalized medicine and explain how studies are necessary for the realization of personalized medicine. Science communicators can be trained through these activities. We are planning to launch the training program for science communicators.

Think tank*Think tank consulting, contract research projects*

We also offer consulting and contracted research services, providing the technical skills and knowledge built up through this program to research institutes, organizations and government agencies for use in better regional medical care and other practical purposes.

highly successful theoretical and practical education can be anticipated.

Through this program, (1) physicians and masters/doctoral degree holders from a variety of different fields will gain a profound and systematic understanding of personalized medicine originating from genomic cohort studies; and (2) numerous specialists with leadership skills will be successively nurtured, and multiple disciplines will be supported by these specialists. Therefore, research will progress efficiently, and societal contributions such as improvement in the clinical setting and public health practices will be realized. The positive impact of the realization of personalized preventive medicine in particular is highly anticipated. Offering high-quality healthcare that complements an aging society with fewer children, a common trend among advanced nations, will become

feasible. These results will not only contribute to maintaining and promoting national health in the 21st century, but they will also offer solutions to major health-care problems, such as increased social security costs attributable to the rapidly aging population.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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