Tohoku University
Advanced Graduate Program for
Future Medicine and Health Care

At the Launching of the Advanced Graduate Program for Future Medicine and Health Care

My name is Keiko Nakayama of the Graduate School of Medicine at Tohoku University. As a program coordinator, I have the great honor of informing you that Tohoku University will start a new graduate school program in April, 2019: the "Advanced Graduate Program for Future Medicine and Health Care". With graduate students who have strong enthusiasm for taking on new challenges and creating something new, we would like to launch this program to provide greater academic proficiency in the medical studies and health care.

Everyone, have you ever seriously considered what is likely to happen 10 years or 30 years from now? This program will cultivate human resources who can keep the future firmly in mind, and being at the forefront, guide society in safe and productive directions.

Nowadays, our society is flooded with information. Events of every moment of our life are going to be recorded as information. Future Medicine will take advantage of useful information in support of our health and welfare, and contribute to the construction of a society in which every person can live a self-supporting and productive life.

From your perspective, what is productive every day? Let's think about it, let's learn it, and let's work together to research and develop it for better Future Medicine.

Keiko Nakayama
Professor, Tohoku University Graduate School of Medicine

Why We Run this Program

1 Requirement for the new concept of medical care and welfare in an unprecedented super-aging society

Japan is moving to the super-aging society. Tohoku University is located in Miyagi prefecture, where its population age composition has already matched Japan's forecast age demographics of 15 years from now. We have encountered the various issues associated with a super-aging society and declining birth rate; such as an increasing number of people living alone, difficulty in accessing medical care, and emerging mental health disorders.

As elderly people tends to suffer chronic diseases, effective health care system needs to be established to prevent, diagnose, and treat particular diseases for the elder. We also believe that it is necessary to develop new paradigms that provide holistic lifestyle support including mental health care. Furthermore, we have to build efficient and comprehensive systems to curb the skyrocketing costs associated with providing medical care and welfare.

2 Nurturing of the right people for Future Medicine

■ Integrating and utilizing vast amounts of medical information

Broad range of medical data; such as human genomes, disease images, medical examinations, and other areas, are rapidly growing in number. Utilization of these big data will be crucial for the development of the effective medical care. However, these immense medical-related data has not been adequately integrated so far. Therefore, the student will be trained on utilizing artificial intelligence (AI) and other technologies to apply this big data on the medical treatment.

■ Utilizing and applying new materials and technologies

A super-aging society is expected to cause not only changes in composition of diseases, but also a decline in the population which alter its age structure. The development of medical devices upon request from changes in social environments will be required, as well as the application of newly developed materials and technologies to medical care and welfare in society for practicing future medicine.

■ Strengthening the cooperation between medical care, health insurance, welfare services, and the administrations in the community

In order for a super-aging society to truly flourish as an affluent society, not only in medical field, society, economics, psychology and other areas need to be integrated as well. In other words, providing comprehensive medical care and welfare services to the elderly will require medical care, health and welfare services, and local administration to share accurate information and goals amongst each other, and it is important to treat and manage the prognosis and risk of disease, together with the improving lifestyle habit of the patients by considering any legal and economical limitations.

Program Objectives

We define this Program as Future Medicine supported by Data Science, Technology and Society (DTS), and set its objective as nurturing talented people who realize Future Medicine. By promoting the study of multidisciplinary and through industry-government-academia collaborations as well as international cooperation, we set out to support the Tohoku region, which is facing a super-aging society at a rate that outpaces the rest of the world, in developing future technologies and personalized medical care, and educating people that can bring future medicine to the world.
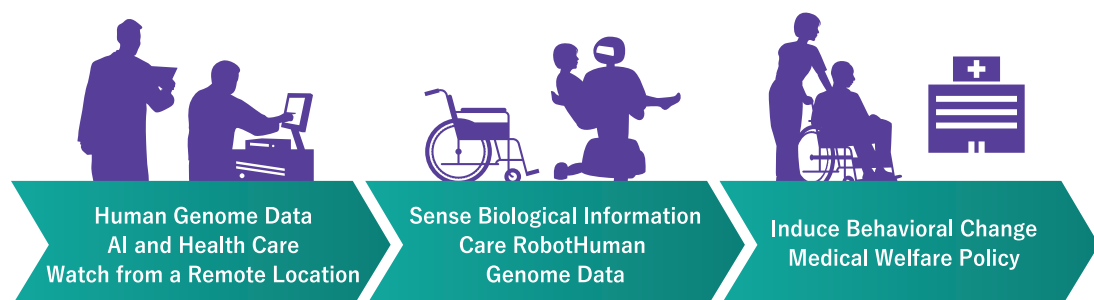
Miyagi prefecture, in which Tohoku University is located, is facing a super-aging society and the declining birth rate that will soon sweep the nation. We attempt to develop future medicine by utilizing these three key resources: The Tohoku Medical Megabank Organization (ToMMo), which structure genome cohort on 150,000 people of local residents; The Academic Science Unit (ASU), which has been jointly set up with a developer of medical devices in the Clinical Research, Innovation and Education Center in Tohoku University Hospital (CRIETO) for developing tools; The Miyagi Medical and Welfare Information Network (MMWIN), which has collected medical data on over 60,000 patients in Miyagi prefecture.

In this Program, we will implement future-oriented field training for an approaching super-aging society with a declining birth rate. The abovementioned three resources will be utilize to train students on the inventiveness and issue-solving abilities. We hope this Program will enable us to work with industry and government to realize a healthy super-aging society.

The needs for medical care in a super-aging society are rapidly shifting from acute to chronic stage medical care, and the composition of diseases is also notably changing. For instance, metabolic syndrome, cancer, dementia, frailty and other chronic illnesses require lifelong control (prevention and treatment). People expect to have access to medical care and a society that provides effective support within the limited medical and welfare resources available, so they can live independently while having such diseases. This requires the realization of personalized medicine and development of new tools and information networks, and the design of systems to implement them in society.

To meet these requirements, it is imperative for us to share knowledge and technologies that go beyond the multi-disciplinary framework, and promote exchanges across multiple professions. This is how we can create the new academic fields in which we must urgently provide the professionals to work.

The outstanding and talented individuals graduated from our Program will have skills to think outside-the-box, and develop capabilities and communication skills that span across specialities. They are also qualified to be leaders in research for developing future medicine, using their advanced data processing skills; spurring innovation in the development of medical devices, utilizing sophisticated information networks; and boldly tackling various issues in medical care, as well as health and welfare from an overarching perspective and by drawing on their extensive knowledge base.

Human Genome Data
AI and Health Care
Watch from a Remote Location

Sense Biological Information
Care RobotHuman
Genome Data

Induce Behavioral Change
Medical Welfare Policy

Specific Curriculum

The Advanced Graduate Program for Future Medicine and Health Care (FMHC) comprises the following three courses.

■ **Data Science Course**

Developing data-based personalized medicine and effective nursing care, and methods for preventing, diagnosing and treating chronic diseases that affect the elderly, etc.
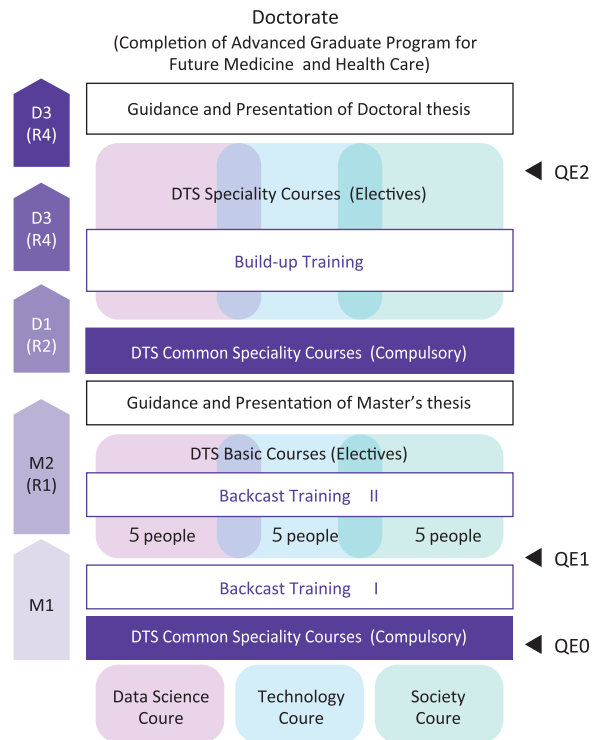
■ **Technology Course**

Applying new technologies to bring about innovations in medical care and welfare, and developing the tools for holistic lifestyle support, etc.

■ **Society Course**

Drafting and implementing practical policies for medical care, insurance and nursing care, and building efficient and comprehensive social systems to curb the skyrocketing costs associated with providing medical care and welfare for the elderly, etc.

Common subjects among the three courses include DTS basic and speciality courses, and backcast and build-up training. The program offers school-wide cross-sectional education that overcomes the boundaries of literature and science.

Backcast training gives students the chance to experience the current situation in Tohoku region, which is what the world will experience in the future. To stimulate their passion for research, we encourage the students to visualize the ideal future and envision the needs that should be accomplished, and also motivate them to work on promptly applying their research results in society. The training has its uniqueness for giving students from a diversity of academic backgrounds the opportunity to train and inexhaustibly brainstorm together. The teaching staffs also have a variety of specialist qualifications, which they utilize to provide mentoring that will create new values.

Doctorate
(Completion of Advanced Graduate Program for Future Medicine and Health Care)

D3 (R4)	Guidance and Presentation of Doctoral thesis
D3 (R4)	DTS Speciality Courses (Electives) ◀ QE2
	Build-up Training
D1 (R2)	DTS Common Speciality Courses (Compulsory)
M2 (R1)	Guidance and Presentation of Master's thesis
	DTS Basic Courses (Electives)
	Backcast Training II
	5 people / 5 people / 5 people ◀ QE1
M1	Backcast Training I
	DTS Common Speciality Courses (Compulsory) ◀ QE0

| Data Science Coure | Technology Coure | Society Coure |

Opportunities for graduate students

Graduate students of this Program will become the new talents who are able to resolve the issues associated with a rapidly aging society as we enter Society 5.0. Working as professionals with extensive knowledge and comprehensive expertise, they will create a synergy effect by sharing their specialist knowledge, and quickly recognize and resolve the needs of a variety of social situations.

We hope this Program will cultivate talented people to society. Those people will be able to identify and promptly resolve the issues associated with an approaching aging society by themselves, and facilitate support for Self-Support System in the society where everyone can live independently.

People & Knowledge Network
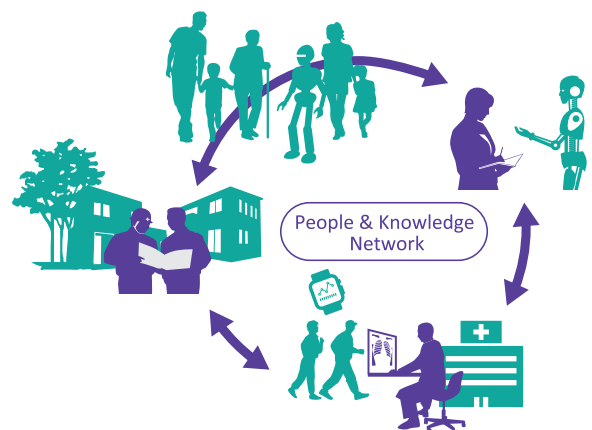
Background

Under the three philosophies of Research First, Open Doors and Practice Oriented Research and Education, Tohoku University has been striving to provide first-class education as a leader in creation and innovation, and as we pursue continuous educational reform.

Tohoku University's mission as an educational institution is to create world-class knowledge and produce talents who will drive innovation that opens a path to the future. Our vision for 2030 is to propel a positive spiral of research, education and social collaboration toward an even higher level. The Tohoku University Institute for Promoting Graduate Degree Programs, which is headed by Prof. Masahiro Yamaguchi (Vice President for Education Reform and Global Engagement) as the director, will spearhead this initiative that will drive graduate level educational reform throughout Tohoku University.
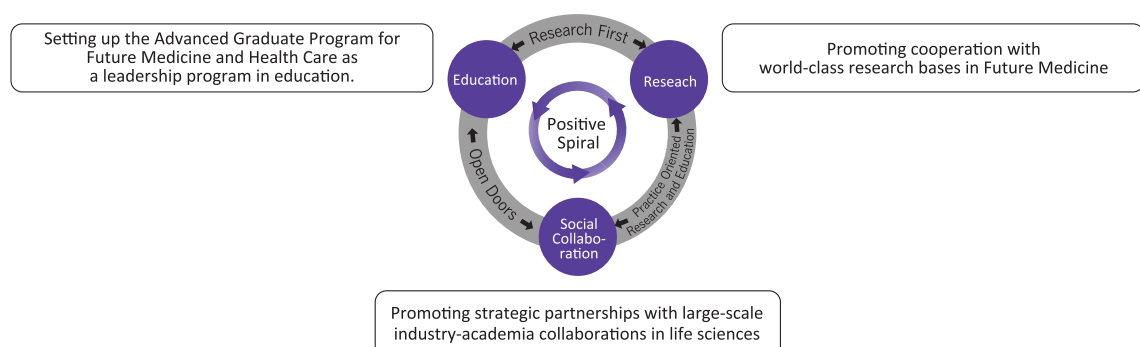
In April 2018, the Institute established the new Division for Academia-Industry Collaborating Graduate Programs; this Division has been set up as base in accordance with the WISE Program (Doctoral Program for World-leading Innovative and Smart Education) run by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

The WISE Program focuses on the core strengths of each university and leverages the achievements of existing graduate level reforms, while systematically collaborating with universities, research institutions, private corporations and other organizations in Japan and overseas. The Program aims to develop five-year doctoral programs with world-class education and research capabilities. It will cultivate excellent doctoral graduates capable of becoming leaders in every industry sector, and promote initiatives to create a first-class base for ongoing student training and exchanges and the continual creation of new research collaborations.

Graduate School of Medicine, Tohoku University provides education to develop medical professionals who will drive forward medicine into the future. The 12 divisions within Tohoku University were organized into the Advanced Graduate Program for Future Medicine and Health Care (FMHC), which was adopted into the WISE Program in October 2018. A total of 15 programs nationwide joined the WISE Program in fiscal 2018, and in addition to the FMHC, the WISE Program for AI Electronics was also adopted. These two WISE Programs at Tohoku University clearly show how the value of our graduate level educational reform initiatives is being acknowledged across Japan.

The Division for Academia-Industry Collaborating Graduate Programs has set up the Education and Research Center for Future Medicine and Health Care, which runs the FMHC. Professor Keiko Nakayama of the Graduate School of Medicine at Tohoku University is the Director of this center, and the office of the Promotion Center is located in Building 1 of the Tohoku University School of Medicine.

The Division for Academia-Industry Collaborating Graduate Programs has set up two centers, including the Education and Research Center for AI Electronics that runs the WISE Program for AI Electronics. Under the direction of its director, the Division works with each center to ensure they are running efficiently. The Division is also working on having a new WISE Program adopted in the next fiscal year, as it continues to pursue an even more well-designed education system.

Setting up the Advanced Graduate Program for Future Medicine and Health Care as a leadership program in education.

Promoting cooperation with world-class research bases in Future Medicine

Research First

Education

Reseach

Positive Spiral

Open Doors

Practice Oriented Research and Education

Social Collabo-ration

Promoting strategic partnerships with large-scale industry-academia collaborations in life sciences