

# Keio University Medical-Engineering Collaboration Project for Advanced Research and Education

## ○Achievements

### ●Fiscal Year 2023

**Educational Activities:** At the medical school, we hosted five first-year students for the Introduction to Medicine seminar and eight students for the lab tour, and three first-year students joined our department and began their research activities. We hosted six third-year students for independent study and provided them with programming instruction. Subsequently, nine third-year students joined our department and started their research activities. One of them is analyzing clinical data. Two fifth-year students in the MD-PhD program continued their research in our course. A total of 10 lectures on Introduction to Extended Intelligence Medicine were given to applicants at all levels of the medical school. At the Graduate School, we hosted a first-year doctoral program student to begin research. A lecture on Introduction to Medicine was given to the master's students. We are also mentoring a high school student as part of the Keio Global Science Campus project. We have also been involved as planners, coordinators, mentors, organizers, and evaluators of the Medical-Health AI-Design Program (MAP). Internationally, we have lectured as part of the AI4ONEHEALTH master's program at the Université Grenoble Alpes in France.

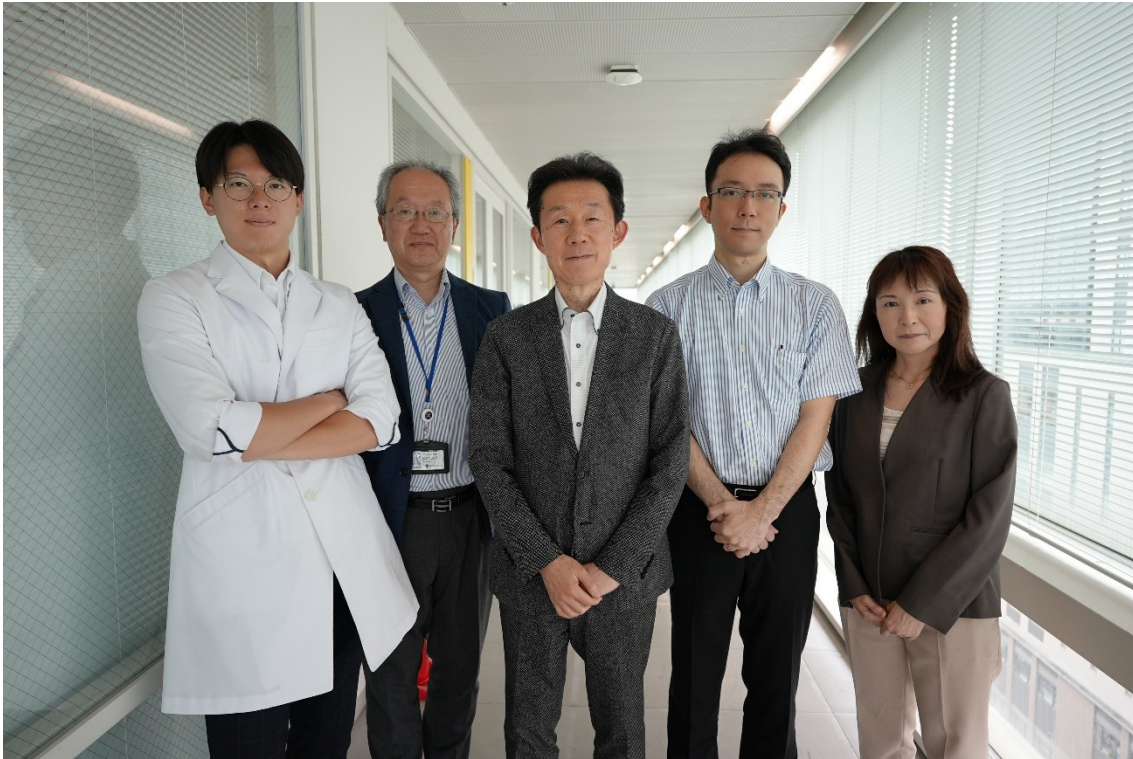
**Research Activities:** Collaborative research was initiated with the Department of Rehabilitation Medicine, the Department of Neurology, the Department of Rheumatology, the Department of Obstetrics and Gynecology, the Department of Dermatology, the Department of Neurosurgery, the Division of Tumor Immunology at the Institute for Advanced Medical Research, and the Center for Preventive Medicine. With the support of the JST Co-Creation Opportunity Formation Support Program (COI-NEXT), we participated in Research Project 2 and implemented the Science Knowledge Data Platform. We developed and published a paper on a universal analysis technique using non-negative tensor decomposition to analyze time-series biomedical data. In collaboration with the Division of Tumor Immunology at the Institute for Advanced Medical Research, we developed a support tool for efficient genetic modification of T cells and published a paper and a press release. Developed a physical theory underlying predictive medicine, also resulting in a published paper and press release.

<https://www.keio.ac.jp/ja/press-releases/2023/11/22/28-154650/> (Japanese)

<https://www.keio.ac.jp/ja/press-releases/2024/1/16/28-156153/> (Japanese)

**Medical-Engineering Collaborative Activities:** We gave a special lecture on "AI Healthcare and Medical Treatment" at the AI and Advanced Programming Consortium (AIC), and began discussions on collaborations with Nanyang Technological University in Singapore and Findata in Finland. This year, we developed a basic theory of predictive medicine that combines principles from physics (non-equilibrium thermodynamics and quantum mechanics) with AI analysis, laying the foundation for a hybrid AI system. To promote interdisciplinary collaboration between medicine and engineering using this core technology, we participated in "Quantum-like Modeling" in Biology, Cognitive & Social Sciences, an event hosted by RIKEN, where we discussed the potential for integrating quantum mechanics with medical science.

<https://ithems.riken.jp/en/events/quantum-like-modeling-in-biology-cognitive-social-sciences>



## ●Fiscal Year 2022

April 2022: Dr. Tetsuo Ishikawa assumed the position of Associate Professor while Dr. Junna Oba and Dr. Ryoichi Yokoyama took up the post of Assistant Professor at the Ishii-Ishibashi Memorial Laboratory. In addition, in October 2022, Dr. Yoshihiro Fujie joined as Project Assistant Professor.

**Educational Activities:** The School of Medicine held an Introduction to Medicine Seminar for first-year students (4 sessions in total) and special lectures for second-year to sixth-year students (10 sessions in total). For graduate students in the Graduate School of Medicine doctoral and master's programs, lectures on AI and medical data science were held (3 sessions in total). At the Joint Medicine/Pharmacy Summer School, Professor Kazuhiro Sakurada delivered a lecture titled "From Artificial Intelligence to Extended Intelligence: Contemplating the Future of Bioscience and Medical Treatment." Two fourth-year students in the physician-scientist training program (MD-PhD Program) began their research.

**Research Activities:** Joint research was initiated with the Department of Rehabilitation Medicine, the Department of Neurology, and the Department of Rheumatology. Under JST, Co-Creation Opportunity Formation Support Program (COI-NEXT), a platform called "Science Knowledge Data Platform" was designed and implemented. This research and development project was designed with the aim of creating an environment in which diverse academia can pool their wisdom and collaborate on data analysis. The implementation of a cloud-based system is currently underway. Associate Professor Tetsuo Ishikawa was invited by the Karolinska Institutet in Sweden and the University of Tübingen in Germany to introduce the latest analysis methods that utilize AI and present the results at a symposium. He also visited the University of Luxembourg, and the University of California, Los Angeles in the U.S., where he had exchanges with local researchers and professors on technology.

**Medical-Engineering Collaborative Activities:** Associate Professor Tetsuo Ishikawa and Professor Kazuhiro Sakurada delivered a special lecture entitled "AI Healthcare and Medical Treatment" at the AI and Advanced Programming Consortium (AIC). Also, at the Faculty of Science and Technology, Professor Kazuhiro Sakurada gave a lecture on "New Bioscience and Medical Treatment in the Age of AI and Data Science" under the theme of "Examining the Forefront of the Combined Technologies of Science and Medicine." In addition, Assistant Professor Ryoichi Yokoyama provided instruction to master's students in the Faculty of Science and Technology on the topic of diagnosing autism through deep learning of brain images sourced from open data.



### ●Fiscal Year 2021

**October 2021:** Dr. Kazuhiro Sakurada assumed the position of the Ishii-Ishibashi Laboratory Chair as a professor. The laboratory was given the name "Department of Extended Intelligence for Medicine". In conjunction with the appointment, the Keio University Steering Committee for Advanced Biomedical Engineering Research and Education Project and the Joint Steering Committee for the Ishii-Ishibashi Laboratory were organized and held, and plans for future education, research, and organizational structure were reported.

**November 2021: [Start of educational activities]** Prof. Sakurada gave a lecture on "Creation of New Medical Care Based on Medical Data Science: From Artificial Intelligence to Extended Intelligence" to second-year medical students.

**[Start of research activities]** Professor Sakurada was appointed as the leader of Research Project 2 of "Urban Health Commons Co-Creation Center for Well-Being by Connecting and Involving Everyone" under JST, Co-Creation Opportunity Formation Support Program (COI-NEXT). This project is responsible for building a platform called "Science Knowledge Data Platform (SKDP)" to integrate medical data (disease names, medical records, specimen tests, image reports and laboratory images, prescriptions, injections, etc.) and post-treatment data (nursing home records, sensor data from homes, etc.) scattered among hospitals, nursing care facilities, IT companies, etc. for advanced analysis by specialists. This data platform is designed to allow specialists to perform advanced analysis. This data platform is composed mainly of information that has been processed using pseudonyms to appropriately protect personal information. In addition, in order to improve the accuracy of analysis using machine learning and deep learning, the data platform provide users with data science techniques such as feature engineering and algorithm selection for solving health care problems. By March, the construction of the core data platform was completed.

<https://www.health-commons.com/randd>

**Feb. 2022:** Tetsuo Ishikawa was appointed as Associate Professor, and Junna Oba and Ryoichi Yokoyama were appointed as Assistant Professor.

**March 2022:** Construction of a laboratory for medical data science was completed on the 9th floor of the Center for Integrated Medical Research (Research Park) at the Shinanomachi campus.

