Goal2 Realization of ultra-early disease prediction and intervention by 2050.

Comprehensive Mathematical Understanding of the Complex Control System between Organs and Challenge for Ultra-Early Precision Medicine

Here begins our new MIRAI
MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

R&D Theme

Mathematical Collaboration with Other Moonshot Projects, Development of Data Base, and ELSI Supporting System

Progress until FY2022

1. Outline of the project

This R&D theme can be divided into two sub-themes: one is "**Mathematical Collaboration with other Moonshot Projects**" and the other is "**Database Construction**". Mathematical collaboration involves the construction of **a mathematical analysis infrastructure** that can be used across the entire Moonshot Goal 2, as well as mathematical collaboration on disease data obtained in Goal 2. In particular, we will construct **a comprehensive mathematical analysis method** for detecting the state of Mebyo just before the transition from a healthy state to a diseased state.
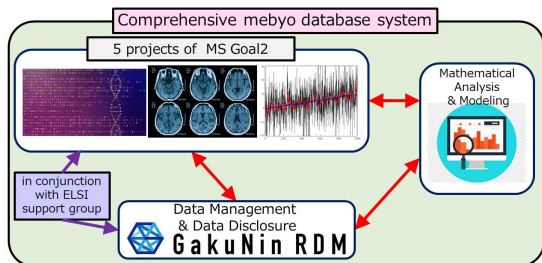
Conceptual diagram of the construction of a comprehensive Mebyo database system

In addition, the database construction aims to compile the results of the entire project, construct **a comprehensive Mebyo database of complex organ regulatory systems**, and make it widely available to society. **In collaboration with all the projects in Moonshot Goal 2**, we will construct a comprehensive

Mebyo database based on experimental data, clinical data, and cross-sectional mathematical analysis data related to each disease.

Through these efforts, we will contribute not only to the project's goals of comprehensive mathematical understanding of complex organ regulatory systems and early precision medicine, but also to the realization of **a society capable of predicting and preventing diseases in the ultra-early stages**, which is **the goal of Goal 2 as a whole**.

2. Outcome so far

In the mathematical collaboration, the construction of mathematical analysis methods and the development of mathematical analysis software have begun in order to start mathematical analysis using artificial data generated by mathematical models and existing open data, etc., in anticipation of data analysis of experimental and clinical data that will be obtained in **the 5 projects in MS Goal 2**. For example, software has been developed and released for each of the Aihara Project's original mathematical analysis methods, such as **DNB analysis and ASURAT**. The released software has been tested on **the GakuNin RDM**, and it has been verified that the software can be used for the entire MS Goal 2. Thus, the construction of the mathematical analysis platform is steadily progressing.

In addition, in database construction, **the Goal 2 database** was designed. For example, database construction is steadily progressing with metadata design and database mock-up creation, and is getting ready for data collection and sharing across the MS

Goal 2. The database working group has started concrete work toward the use of the database for the entire Goal 2 project.
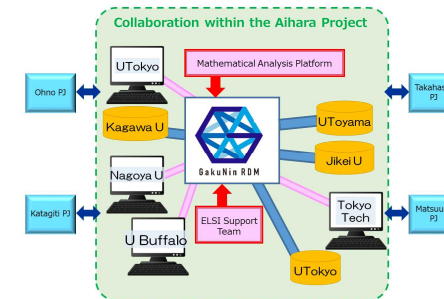
In addition, we are working closely with **the ELSI support team** to consider appropriate responses to ethical, legal, and social issues (ELSI) that may arise in comprehensive Mebyo database construction.

3. Future plans

In mathematical collaborative research, we will continue to build **a data sharing system to continue to promote mathematical collaboration with each project under Goal 2**. In addition, we will continue to construct a mathematical analysis platform that can be used **across the entire Goal 2**. By releasing various mathematical analysis methods as software that can be used by anyone in Goal 2, it is expected that mathematical collaboration will be promoted.

As for the database construction, the database design will be completed and data sharing within Goal 2 will be promoted as soon as possible. To this end, we will resolve issues related to data sharing and promote data storage by taking **a leading role within Goal 2**. In addition, we will work with **the ELSI support team in our project** to create a database white paper in order to establish common usage methods and rules for the comprehensive Mebyo database construction.