

Development of AI for microbiome analysis to accelerate personalized prevention of diabetes

Program Director

YONEDA YoshihiroDirector General, National Institutes of Biomedical Innovation,
Health and Nutrition (NIBIOHN)

Original measure: Construction of a database of gut microbiota in healthy Japanese people for the establishment of new prevention methods for lifestyle-related diseases (MHLW)

Issues and Goal

Aiming at personalized prevention of diabetes from the perspective of the gut environment

- ✓ In the United States and other countries, large-scale projects targeting microbiome such as gut microbiota are underway on a national scale, while in Japan, each research institute is collecting data on a relatively small scale, mainly targeting diseased individuals.
- ✓ NIBIOHN has been constructing a database of healthy Japanese people, and in this measure, we will expand the database and conduct similar analysis for diabetic patients, analyze the genome of useful microorganisms related to prevention and improvement of diabetes and search for and select postbiotics, which are useful metabolites produced by microorganisms. In addition, we will develop production systems and search for and develop alternative foods to accelerate development and expansion of the healthcare industry for lifestyle-related diseases including diabetes.
- ✓ By integrating with other cohort studies for linking and comparing data, we will enhance the functions of the database and AI, which will lead to personalized/stratified prevention of lifestyle-related diseases such as diabetes as well as development of personal healthcare products.

Overview

Construction of microbiome database with metadata and analysis using integrated analysis platform

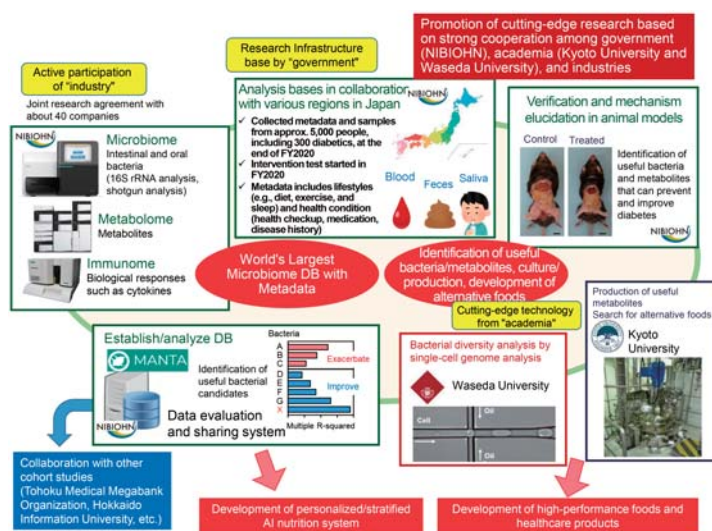
NIBIOHN has been working since FY2015 to build a microbiome database and make it available to the public in the original measure, and as of the end of FY2020, we built a microbiome database of 5,000 healthy individuals that includes a wealth of metadata on their lifestyles. Then, by using our unique integrated analysis platform named MANTA, we started analyzing the data.

In PRISM, we will expand the database and carry out similar analysis on diabetic patients to analyze useful microorganisms that contribute to prevention and improvement of diabetes, and to search for postbiotics, which are useful metabolites produced by microorganisms. In addition, by developing production systems and searching for and developing alternative foods, we will accelerate development and expansion of the healthcare industry for lifestyle-related diseases such as diabetes.

Identification of bacteria and metabolites useful for diabetes prevention, elucidation of their mechanisms of action, and development of production systems and alternative foods

Based on analysis of human data, we have identified candidates of useful microorganisms and metabolites that lead to prevention of diabetes and have been verifying their usefulness and elucidating their action mechanisms using animal models. For those that have been confirmed to be useful, we are developing production systems and foods that can substitute their functions.

By conducting this series of research in collaboration with other cohort studies, many companies are using our research results as a platform for development of personalized/stratified AI nutrition systems, functional foods, and healthcare products.



Achievements to date and expected positive ripple effects

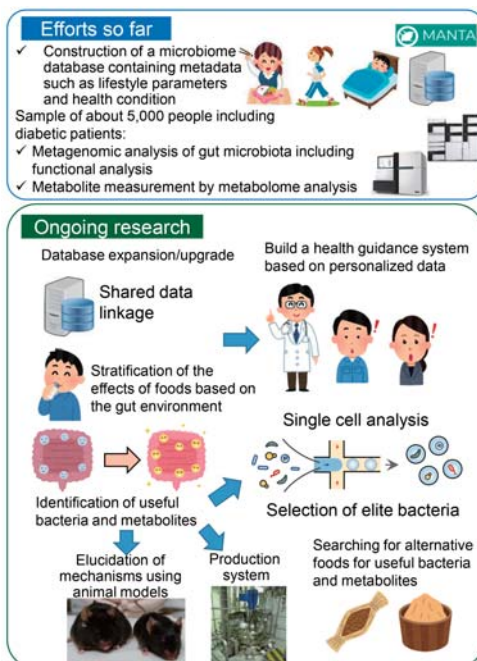
Data collection and analysis, cohort collaboration, social implementation

In addition to our own cohort studies in Yamaguchi and Osaka prefectures, we have been sampling and collecting data in various parts of Japan in collaboration with other institutions and are now conducting integrated analysis of the obtained data using MANTA, our original analysis platform. We have already collected and analyzed data of more than 5,000 people and are working on a new system to provide health guidance based on individual data by considering regional characteristics and by returning individual gut environment data to participants. In addition to academic institutions including more than 20 universities, we have signed joint research agreements with about 40 companies (contribution equivalent to about 700 million yen) and are working on social implementation through stratification of the effects of various foods, new health measurement systems, and food functionalization.

Identification of useful bacteria/metabolites, elucidation of mechanisms, and production

Based on analysis of data obtained from human and animal models, we are identifying useful bacteria and metabolites (postbiotics) that contribute to prevention of diabetes. We have already elucidated the mechanisms of action of some of these metabolites using animal models and molecular biological methods and are moving forward with development of production systems. As for useful bacteria, we are conducting single-cell analysis to select strains with superior efficacy (elite bacteria) and elucidating useful substances produced by elite bacteria and their mechanisms of action. Also, we are searching for ingredients that can replace useful bacteria and metabolites, focusing on various fermented foods.

These achievements are expected to contribute to development of the healthcare industry in the near future through development of a new health guidance system and functional foods from the perspective of gut microbiota and other gut environments.



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Issues and Goal

Giving shape to the promotion measure of industrial utilization of cohort biobanks

Under the subject of “establishment of large-scale integrated cohort-based biobanks” in the “Bio-Strategy 2019”, it was clearly stated “to establish large-scale healthy participant cohort-based biobanks in which the host organizations of healthy participant cohorts, etc., cooperate to integrate and strengthen data” and “to develop an environment in which services based on scientific evidence in various fields can be provided for the healthy participant cohort biobank”. The FY2019 survey identified several challenges to solve before industrial use of large-scale integrated cohort-based biobanks as follows: (1) utilization of cohort data is limited to research purposes, (2) the food and healthcare industries tend to require a large amount of data because the effects are more moderate than in the medical field, resulting in the correlation between intervention/exposure-effects being low, and (3) there is currently no hub function to solve the issues for industrial use. The Tohoku University Tohoku Medical Megabank Organization will conduct “proof of concept for data linkage to establish next-generation infrastructure for biomedical data” to address the issues above through the steps of (1) enabling utilization of cohort data for industrial purposes, (2) building a data linkage infrastructure, and (3) examining how the hub function should be.

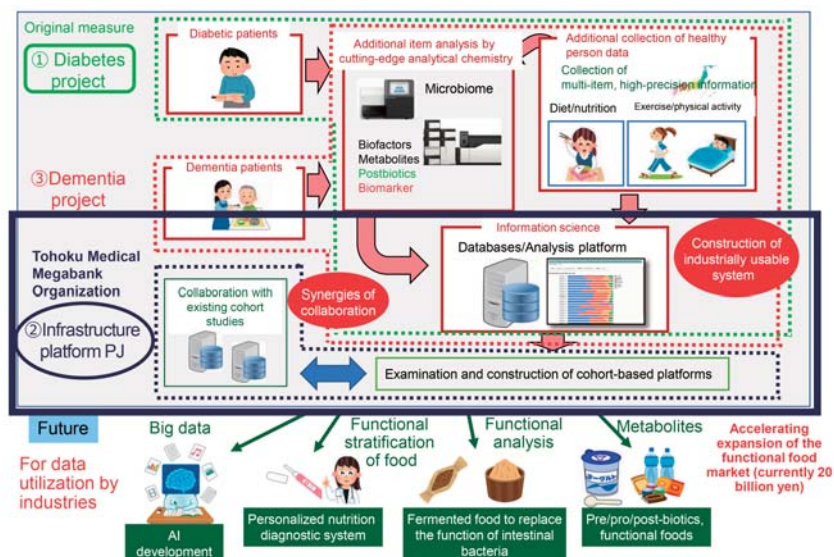
In FY2020, we designed and built a next-generation biodata infrastructure to promote industrial use of cohort biobanks.

Overview

Realize evidence-based health care through a cross-search system and a consultation desk for companies

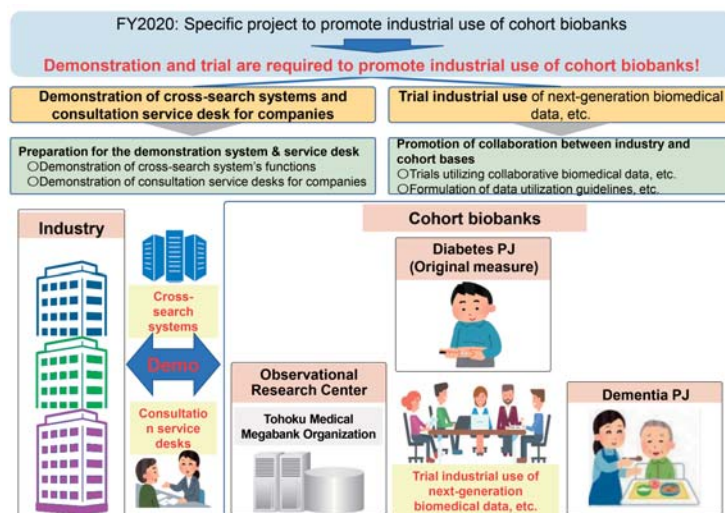
In the original measure, we started working to build and openly utilize the microbiome database in FY2015. As of the end of 2020, we have built a microbiota database of 5,000 healthy participants that contains abundant metadata such as about their lifestyle.

In this measure, we will create an infrastructure platform to link the information accumulated in the various cohorts including those of the original measure and prepare a consultation service desk for industry so that they can utilize the database positively to create an evidence-based, data-driven healthcare industry.



Achievements to date and expected positive ripple effects

Started demonstration and trial industrial use necessary for promoting industrial utilization of cohort biobanks



Expected positive ripple effects

- First, by integrating information of biochemical data such as gut microbiota and metabolites targeted by PRISM's 2 tasks (diabetes project and dementia project) with disease morbidity information and environment/lifestyle information, an environment will be created in which companies in various fields (health, sports, food, etc.) can provide services based on scientific evidence.
- Achievement of data linkage between different databases is expected to lead to creation of new industries based on cohort data, which has never been verified worldwide.
- From the perspective of medical care and healthcare, development of products that contribute to health will be promoted, which not only promote the health of the people, but is also expected to expand existing markets or create new markets.