

**Japanese-German-French Forum on AI and Healthcare
Quality Standards for AI Application in Healthcare and Joint Database for
Medical data**

Session II

Joint Database for Medical Data

December 2nd, 2019

RIKEN

Medical Sciences Innovation Hub Program (MIH)

Deputy Program Director

Kazuhiro Sakurada, Ph.D.

Why we have to construct trilateral collaboration on AI aided healthcare

■ United state

- Private sector driven
- GAFA

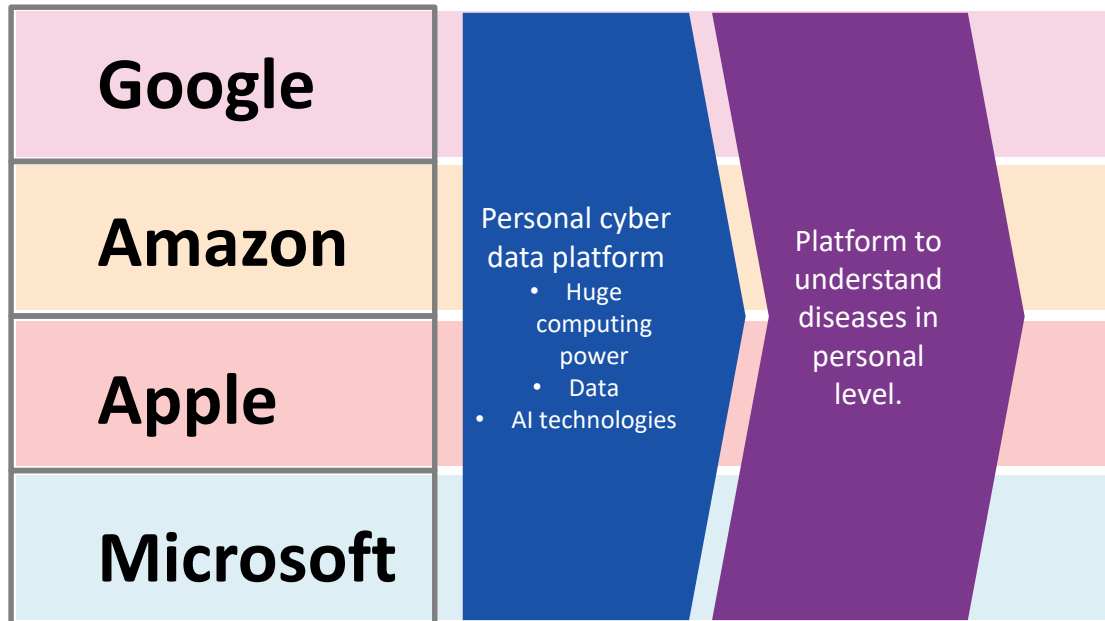
■ China

- State driven (lack of self determination)

■ Japan, Germany and France

- Third road
 - Quality Standards for AI in Health Care
 - Joint Database for Medical Data

Medical innovation by tech companies in US



Understanding diseases in personalized manner

Data mining technologies for personalized recommendation of commercial goods, books, music, and movies cannot apply to personalized and prevention of diseases.

What variables should be measured ? How to make reasoning ?

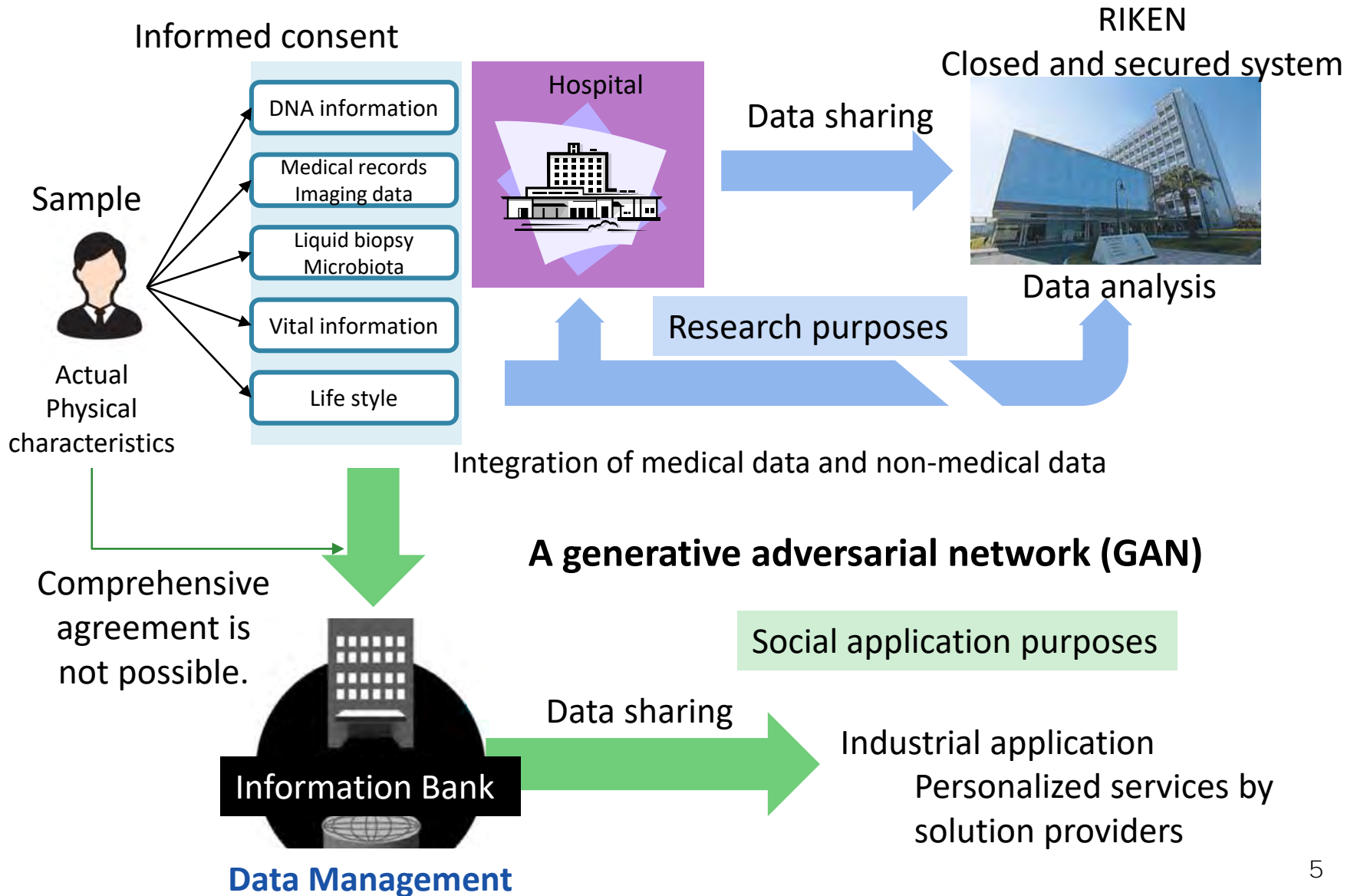
Ontology model for data driven approach is lacking.

What is the purpose of medical data integration

- Improve diagnostics in the present medical framework
 - The stratification of disease (Combination imaging data and AI)
 - Reduction of adverse medication events
 - Identify the causes of disease (Text mining, mechanism analyses))
 - Discover new treatments and medicine

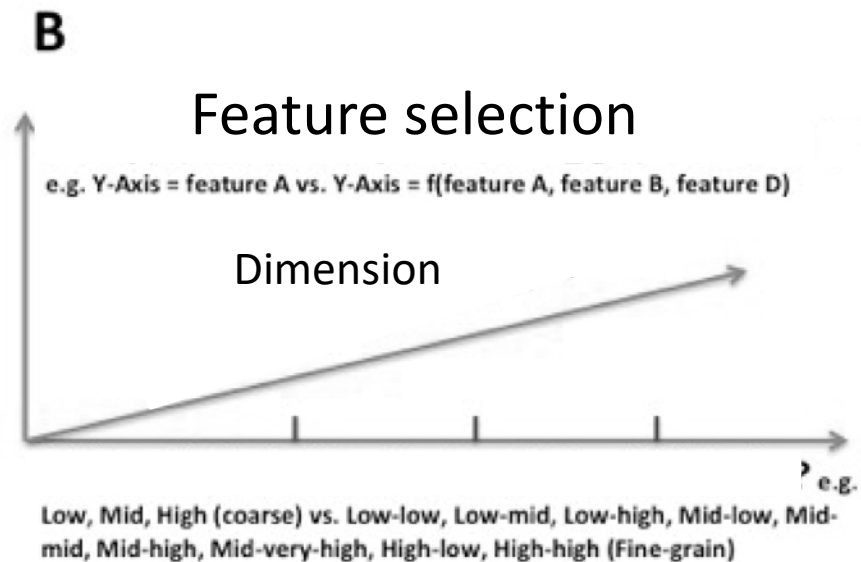
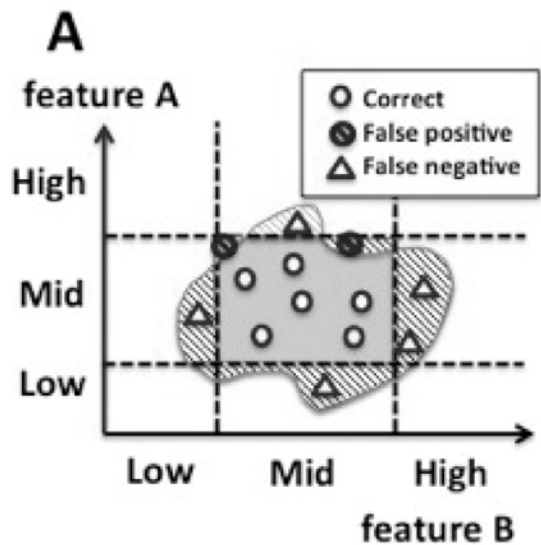
- Actualize 4P (predictive, preventive, personalized & participatory) medicine by paradigm shift in biomedical sciences
 - Personalization by genotyping
 - Personalization by deep phenotyping

Protection of personal information and data sharing



Data to be integrated

- Text mining in healthcare
- Non-verbal information derived from medical devices
 - Imaging data
 - Non-imaging data (Biomarkers, physical markers etc.)



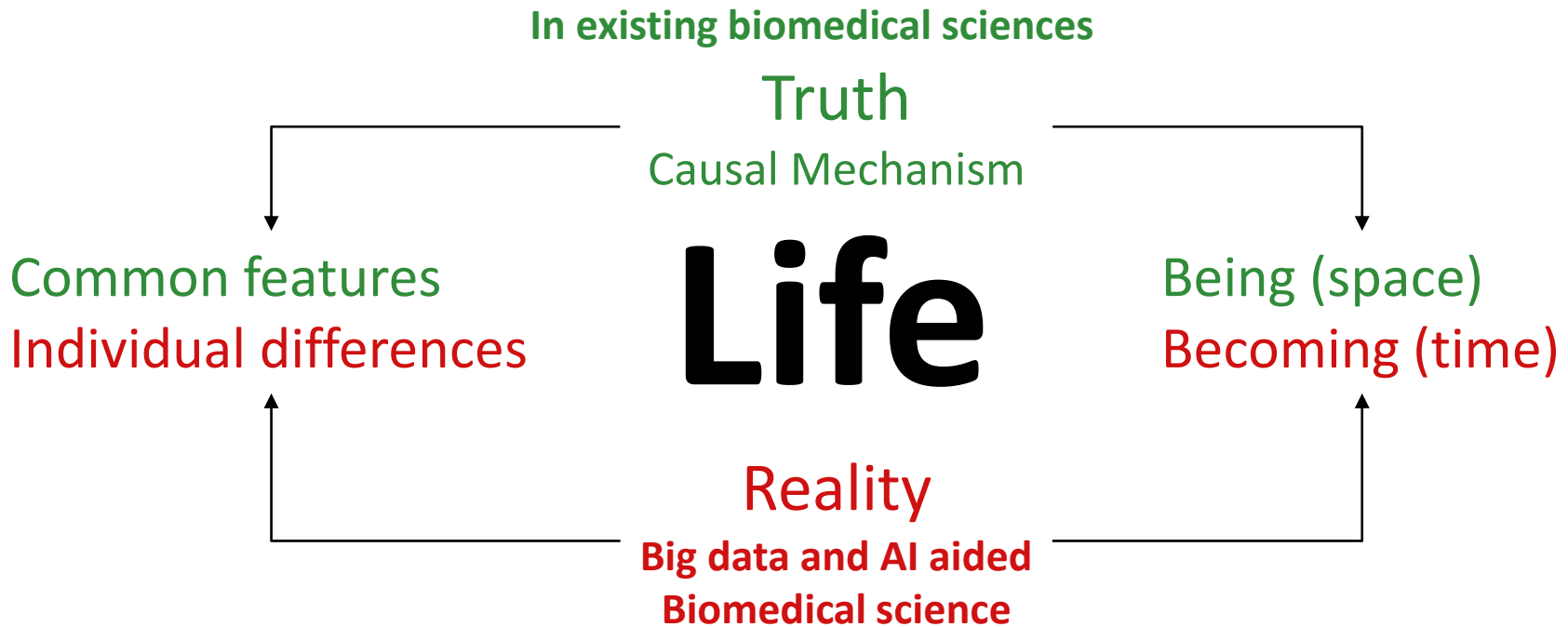
Data Granularity

Q1 What is the obstacles of medical data integration

- Standardization of measurement
- Data integration architecture
- Data import from hospital to data analysis centers
- Data management
- Data integration
- Data sharing
- Standardization of reasoning

Q2 What is required for sustainable Healthcare ?

- Treatment for All
- Predictive, Preventive, Personalized and Participatory (4P) Medicine
- A Longitudinal big data and AI aided Healthcare
- Quality standards for AI in Health Care



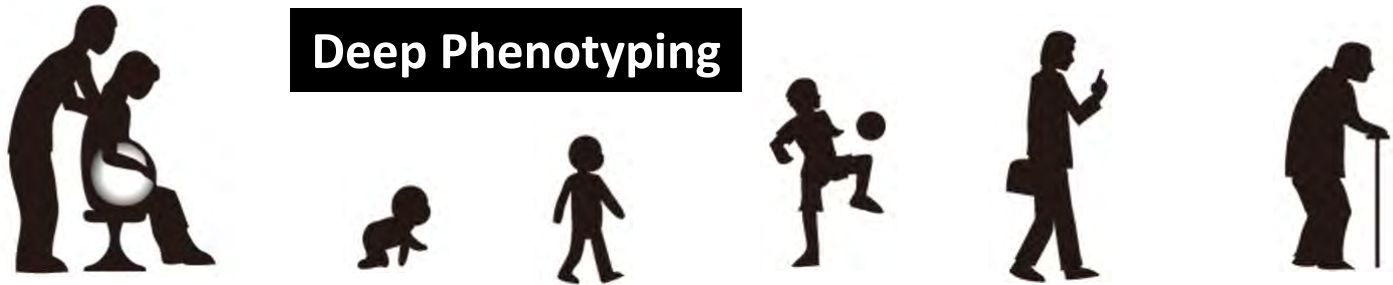
To understand individual differences and becoming

Describe physical space as life course

Genetic Information

We have to overcome existing approaches.

Deep Phenotyping



Pregnancy

Infant & baby

Puberty and Adult

Elderly

Maternal Immune Activation → brain inflammation → → → → → → Dementia

Mental & Physical disorders

Deficiency of nutrition
Social stress
Sleep disorder
Infectious diseases

Sleep disorder
Rhythm disorder
Developmental disorders
Immune diseases
Metabolic diseases

Chronic fatigue syndrome
Mental diseases
Depression, Schizophrenia
Non-communicable diseases

Life course data (Observation)

To approach reality of life

Conceptual tools

Categorization

Describe information as geometrical entities (Information geometry)

Reasoning

Self organization & synchronization of non-linear oscillator. (First principle)

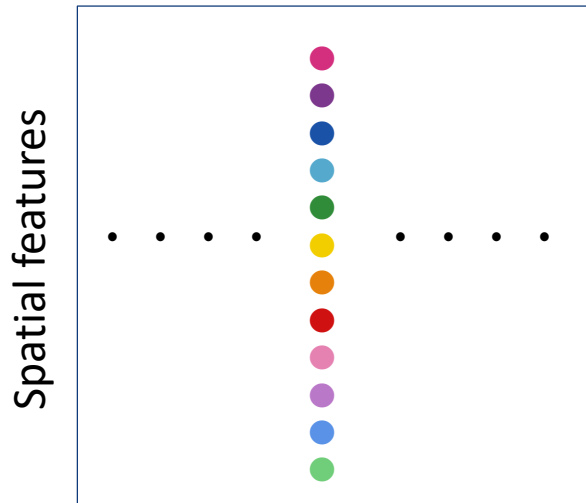
- High dimensional data
- Discrete data
- Non-linear interaction
- Self-organization, emergent features

Understanding organisms as nonlinear dynamical systems by combining information geometry and synchronization

Phenotypes in Life course



Time direction →

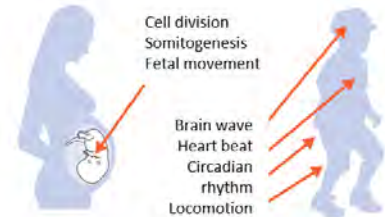


Multimodal time series data

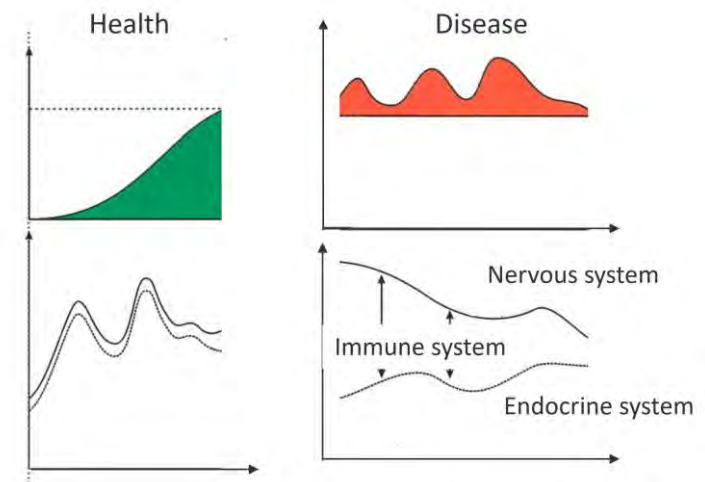
$$\begin{bmatrix} q_1 t_2 \\ q_2 t_2 \\ \vdots \\ q_n t_2 \end{bmatrix} = \begin{bmatrix} P_{1,1} & \cdots & P_{n,1} \\ P_{2,1} & \cdots & P_{n,2} \\ \vdots & \cdots & \vdots \\ P_{n,1} & \cdots & P_{n,n} \end{bmatrix} \times \begin{bmatrix} q_1 t_1 \\ q_2 t_1 \\ \vdots \\ q_n t_1 \end{bmatrix}$$

State transition probability

Koopman Spectral Analysis



Time direction →



Decompose dynamic mode into spectral properties of the linear

Model Reduction and Decompositions

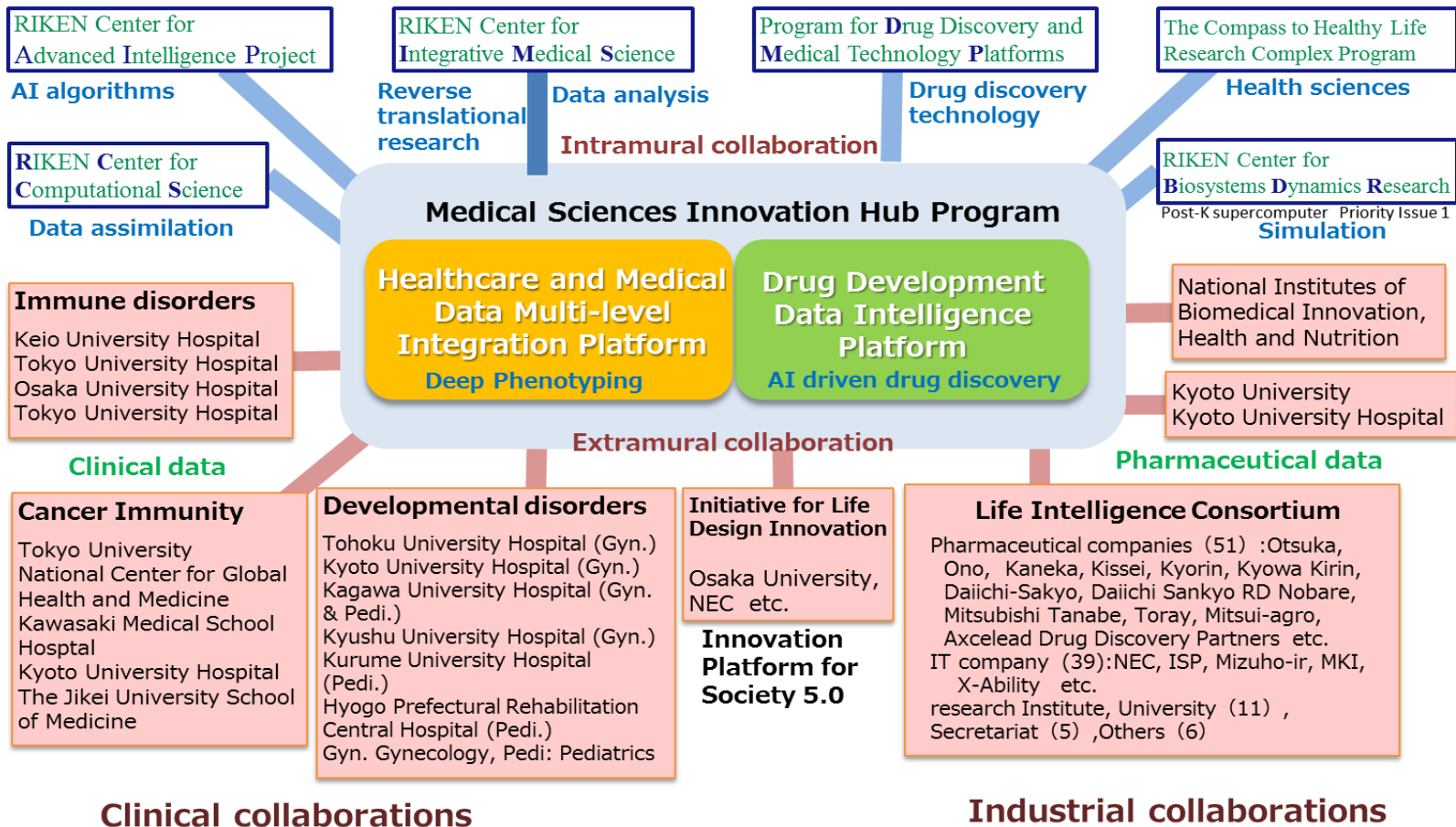
Kazuhiro Sakurada

Experimental Medicine (Japan) 35:1:2-14

Initiate interdisciplinary research projects by trilateral collaboration

Mathematician doesn't know what life is.

Mathematics is necessary to understand life.



THANK YOU

Kazuhiro Sakurada

✉ Kazuhiro.Sakurada@riken.jp

Cyber Physical System in Healthcare

