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

Closing Panel

Expanding human intellect by combining artificial intelligence and humanity
- New healthcare in AI era-

December 2nd, 2019

RIKEN

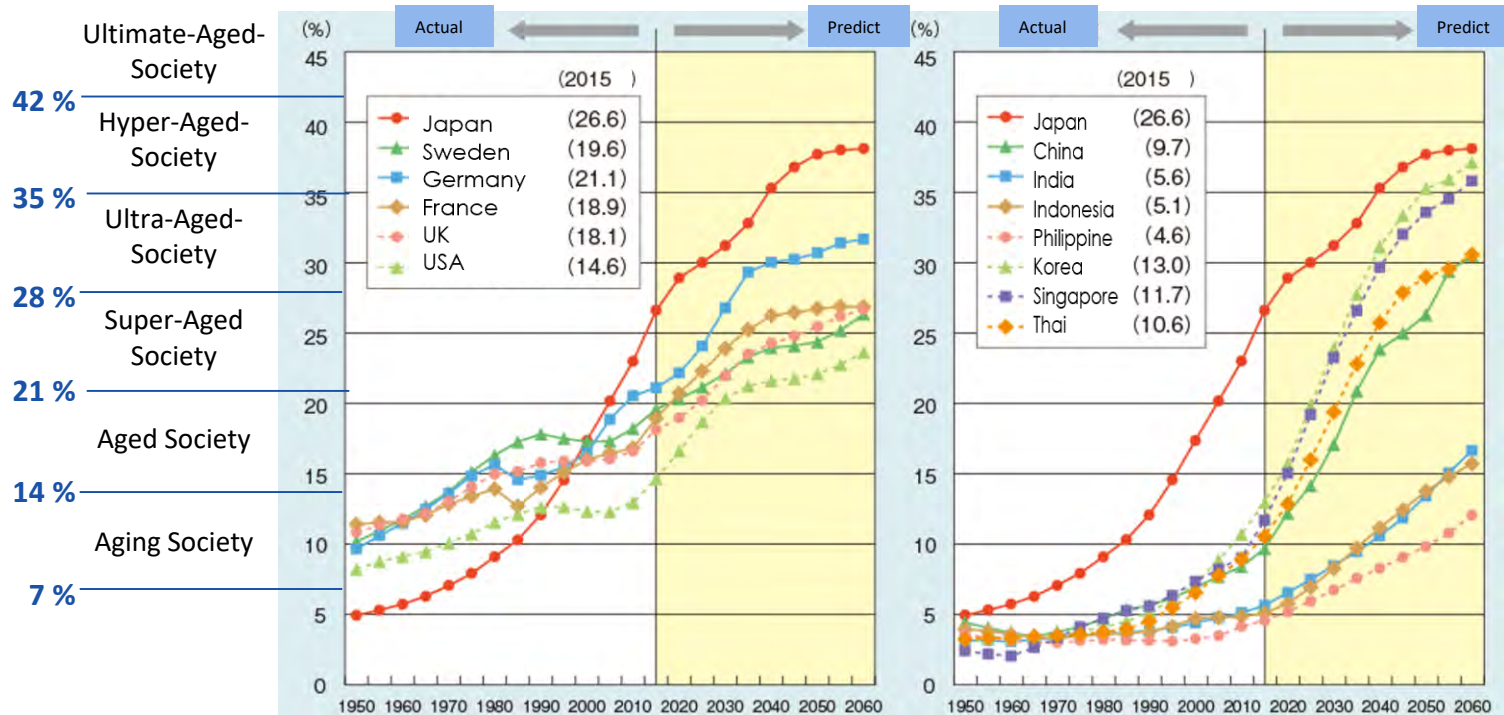Medical Sciences Innovation Hub Program (MIH)

Deputy Program Director

Kazuhiro Sakurada, Ph.D.

Population aging in Japan, Germany and France

Population aging rate

The ratio of people aged 65 years and over

In 2018, ratio was 28 % in Japan, 21 % in Germany and 20% in France.

If the total medical cost increase by using expensive high-level medical services for elderly, universal health coverage will be destroyed.
We have make change to provide lifelong preventive health to all citizen.

Redefine health for sustainable medicine

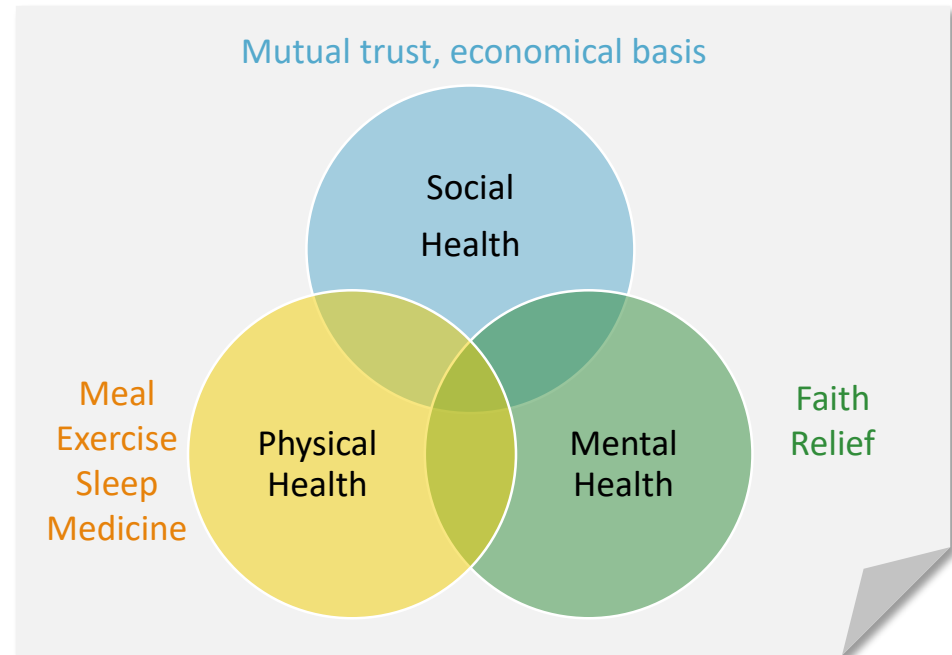CONSTITUTION OF THE WORLD HEALTH ORGANIZATION (WHO)
Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Placebo effect indicates that physical state and psychological state are deeply interacting.

Integration of Mind, Body and Society

Stephen Hawking was diagnosed with ALS when he was 21 and given 2 years to live. However, after living with the disease for more than 50 years, he died on 14 March 2018 at the age of 76. Stephen Hawking had significant physical disability but had a state of complete physical, mental and social well-being.
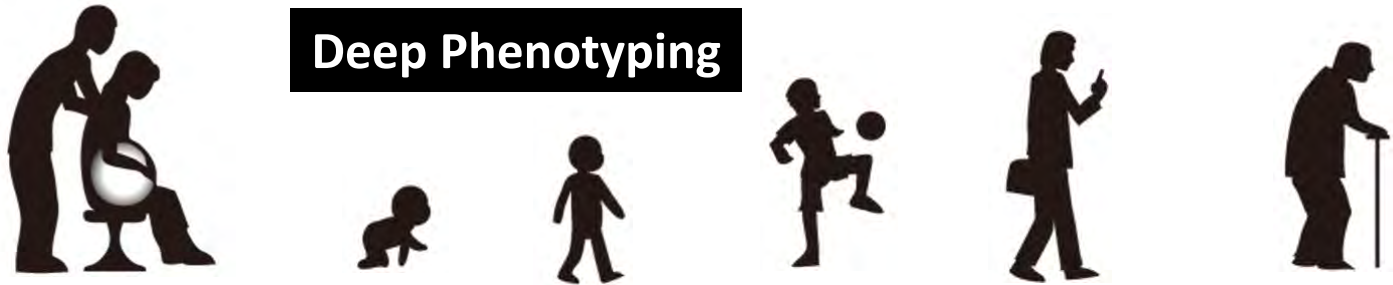
Life course data driven medicine (data integration

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)

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

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））
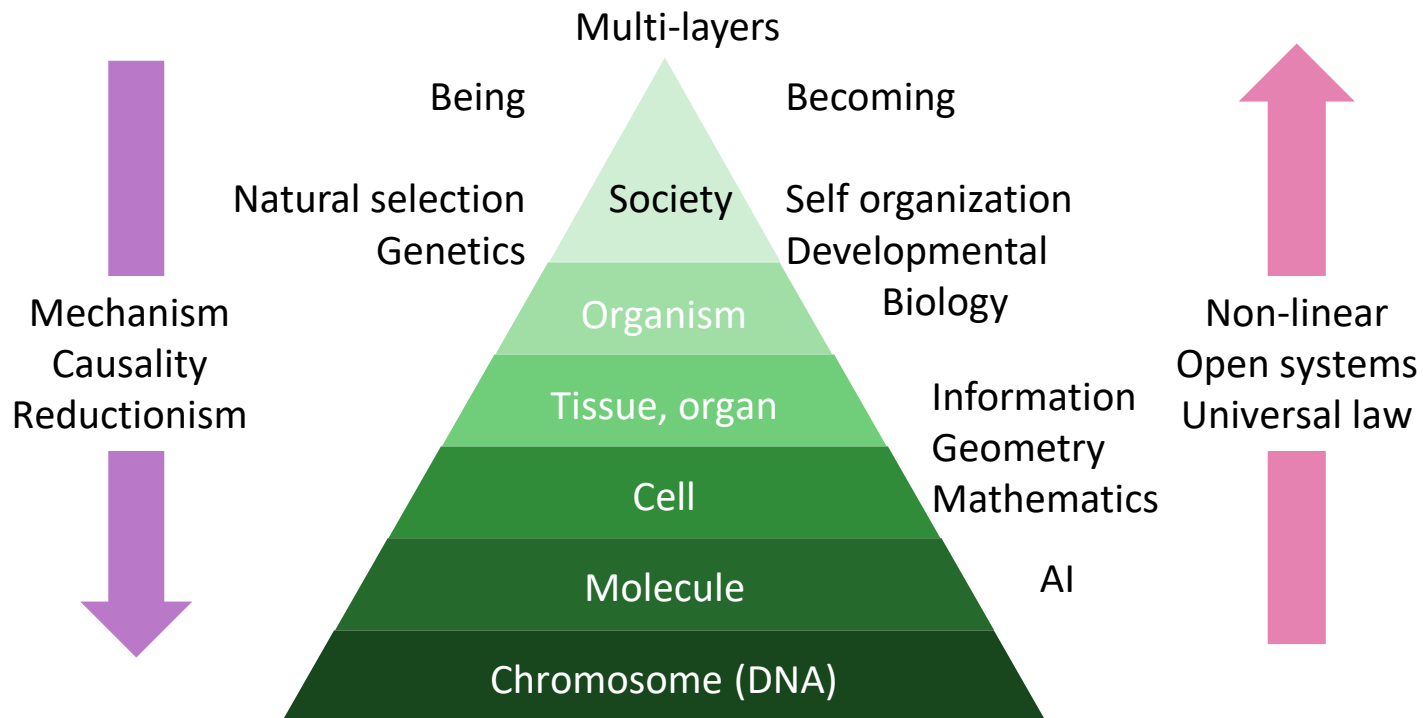
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Q1 How to cross the boarder of biomedical sciences, mathematics and AI ?

Observation (Big data aided) ⟶ **Interpretation (AI aided)**

Overcome human recognition limits

Hypothesis driven
Biomedical science

Data driven
Biomedical science

Multi-layers

Being   Becoming

Natural selection   Society   Self organization
Genetics   Developmental
                                           Biology

Mechanism   Organism   Non-linear
Causality   Open systems
Reductionism   Tissue, organ   Information Universal law
                                        Geometry
                         Cell   Mathematics

                       Molecule   AI

                   Chromosome (DNA)

Q2 What is the basis for personalized solution ?

Beyond Evidence-Based Medicine

Stacey Chang, M.S., and Thomas H. Lee, M.D.

N ENGL J MED 379;21 NEJM.ORG   NOVEMBER 22, 2018

"Interpersonal medicine," a disciplined approach to delivering care that responds to patients' circumstances, capabilities, and preferences.

Intelligence and Intellect

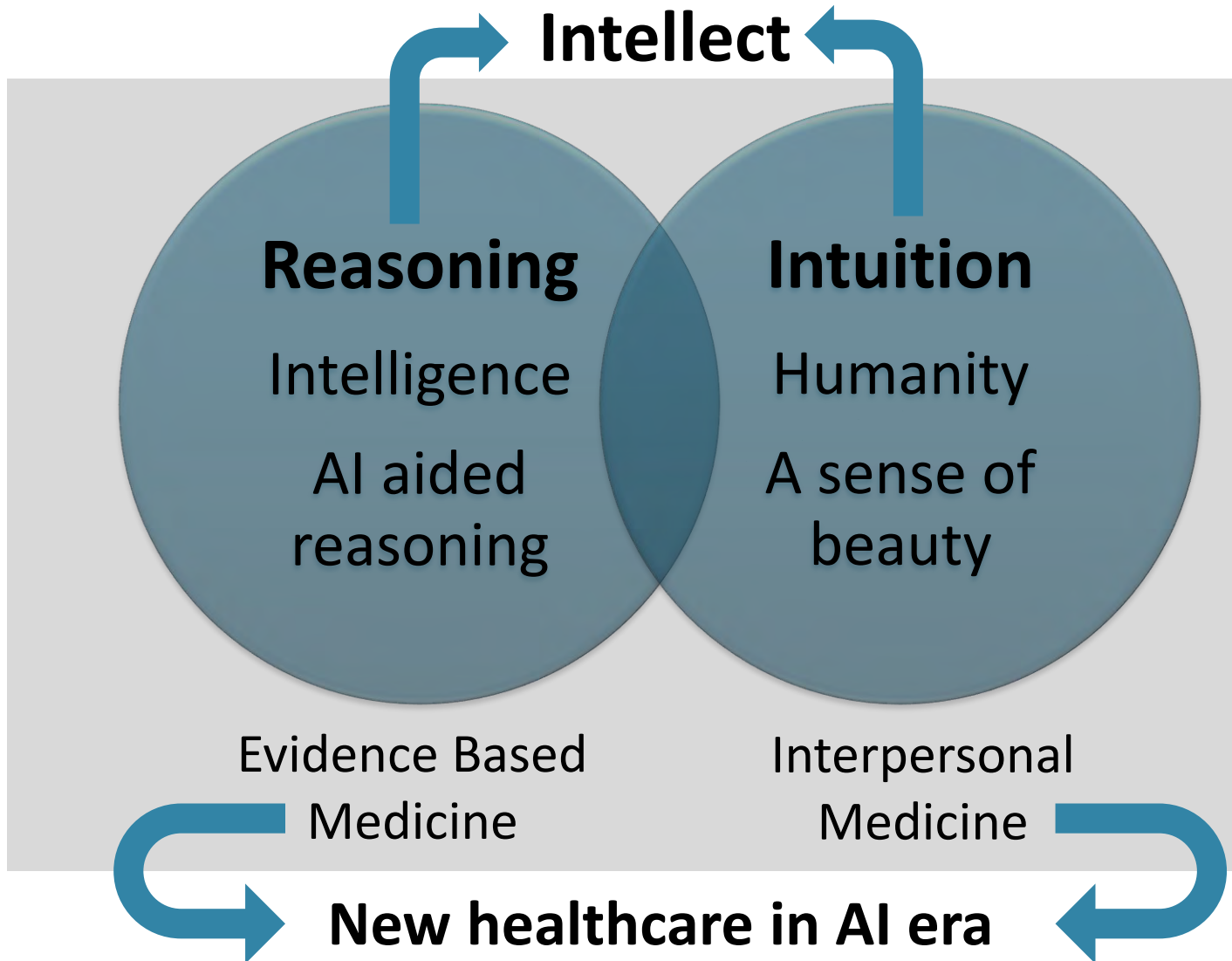| Intelligence See what you want to see	Intellect See what you can't see
■ Intelligence works within the framework of limited but clearly stated goals, and may be quick to shear away questions of thought that do not seems to help in reaching them.	■ Intellect is the critical, creative, and contemplative side of mind.
■ Intelligence seeks to grasp, manipulate, re-order and adjust.	■ Intellect examines, ponder, wonders, theorizes, criticizes and imagines.
■ Intelligence will seize the immediate meaning in a situation and evaluate it.	■ Intellect evaluates evaluations, and looks for the meanings of situations as a whole.

Q3 How to expand human intellect by combining artificial intelligence and humanity

Intellect

Reasoning

Intelligence

AI aided reasoning

Intuition

Humanity

A sense of beauty

Evidence Based Medicine

Interpersonal Medicine

New healthcare in AI era

THANK YOU

Kazuhiro Sakurada
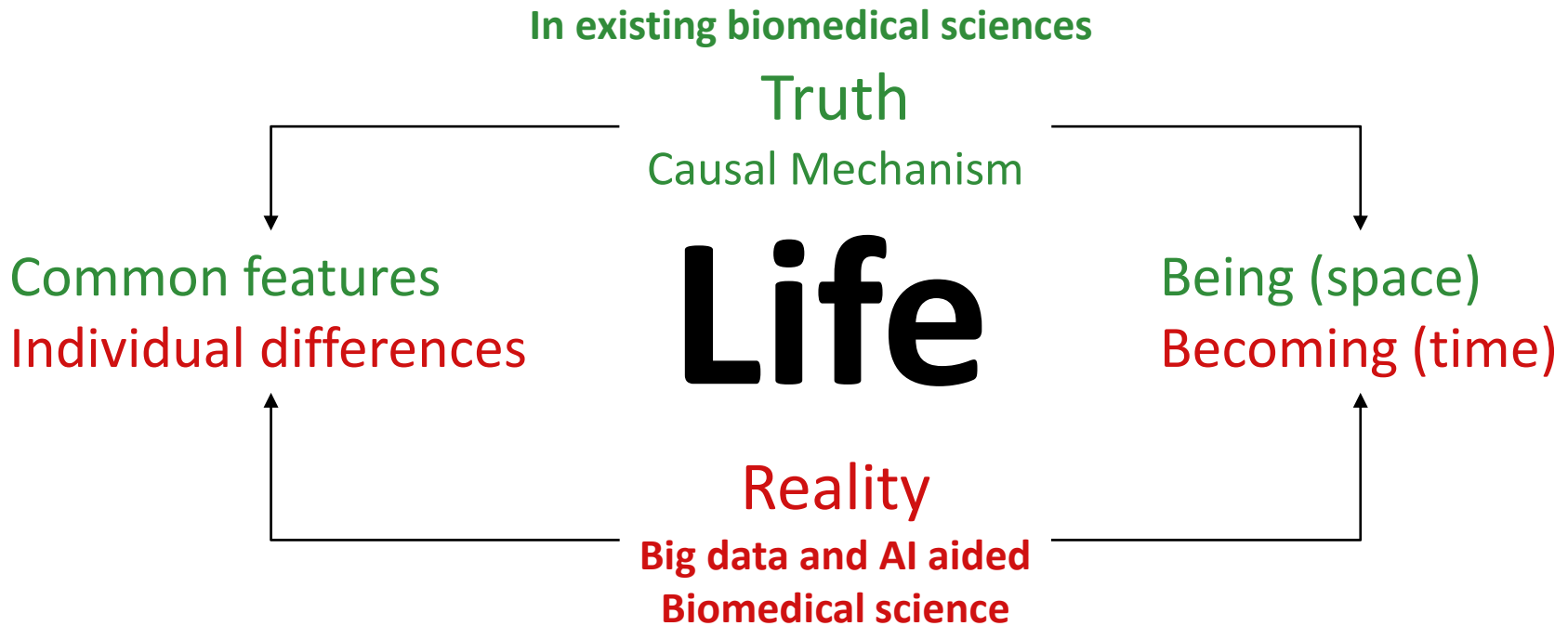
✉ *Kazuhiro.Sakurada@riken.jp*

Understanding, Meaning & Concept in AI era

We try to see what we can't see.

- What is understanding ?
    - □ Understanding is to predict hidden pattern in our experiences by classification.
    - □ **Classification is identification of similarities in our experiences**
- What is Hidden things ?
    - □ Hidden things that we would like to understand are mind of other person, health & diseases of human and principles of nature
- What is meaning ?
    - □ Meaning is the content of prediction.
- What is concept ?
    - □ We usually predict mind of other persons by "delight, anger, sorrow & pleasure"
    - □ Concept is classification (stratification) criteria using multimodal data of our experience
    - □ Pattern is described in concept space
    - □ **There is no correct answer against classification (stratification)**

Sustainable Healthcare ?

- **Treatment for All**

- **Predictive, Preventive, Personalized and Participatory (4P) Medicine**

- **A Longitudinal big data and AI aided Healthcare**

In existing biomedical sciences

Truth
Causal Mechanism

Common features
Individual differences

Life

Being (space)
Becoming (time)

Reality
**Big data and AI aided
Biomedical science**

Trilateral collaboration to initiate new medicine

- Improve diagnostics in the present medical framework
  - ☐ The stratification of disease by combing imaging data and AI
    - → Reduction of adverse medication events

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