

Outline of Selected Project

Host institution	Osaka University
Center name	Premium Research Institute for Human Metaverse Medicine (PRIME)
Head of host institution	Shojiro Nishio
Prospective Center director	Kohji Nishida

<Project Summary>

Conquering all diseases is an ambitious goal that has persisted throughout human history. To achieve this goal, creation of novel scientific field is necessary to comprehensively and continuously understand the process of disease onset that occurs in each individual human body.

PRIME will integrate organoid-based biomedical science with information and mathematical sciences for the first time in the world, and further promote fusion research with quantum sciences, humanity and social sciences and clinical medicine to construct “digital twins” of human body (biodigital twin) that can precisely reproduce in cyber space the biological phenomena and pathological processes in human organs. Specific framework consists of: (1) constructing organoids from humans in healthy, pre-symptomatic, and diseased states, (2) introducing genetic and environmental perturbations to the organoids, (3) measuring their responses by advanced measurement techniques, (4) analyzing the measured data and constructing models utilizing information and mathematical sciences and (5) refining the models through repeated verification and model reconstruction to achieve the reproduction as a biodigital twin. Using biodigital twins, we will promote interdisciplinary fusion research focusing on 9 diseases associated with eye, liver, brain, heart, and reproductive organs along with inter-organ network.

Our challenges will lead to creation of a new scientific field, i.e., human metaverse medicine, where we will elucidate human disease mechanisms, predict onset, progression, and patient treatment response to disease, and develop preventive therapeutic methods. Further, we will launch the information space platform of “human metaverse” for sharing and utilizing the biodigital twins by researchers and medical professionals worldwide. PRIME will provide research environment where various researchers will mingle and interact with each other to conduct fusion research, and foster next-generation human resources to lead the human metaverse medicine.

<Remarks>

1. This proposal aims to establish human metaverse medicine by making a biodigital twin of humans by combining organoid biomedical science and information/mathematical sciences. This is expected to bring great advances in understanding and curing multifactorial diseases including age-related, reproduction-related, and development-related human diseases.

2. The PIs, including the proposed director at Osaka University, are top leaders in the field of human organoids research. Excellent researchers in fields of information/mathematical sciences at Osaka University and its satellite labs participate in the project as PIs. The synergistic

effects of these groups are expected to attract a large number of talented people and lead the center to success.

3. The host institution has committed strong support to the center in terms of infrastructure, personnel and funding. The center is aligned to the strategic vision for the future of the host institution.



Director
Koji Nishida

Conquering all diseases is an ambitious goal that has persisted throughout human history. To achieve this goal, we will establish a WPI center that will create a completely new scientific field, Human Metaverse Medicine, which integrates organoid-based biomedical science with information and mathematical sciences for the first time to comprehensively and continuously understand the processes leading to disease onset that occurs in each individual human body.

Organoid: a miniature three-dimensional tissue that mimics an organ of human or others

Mission

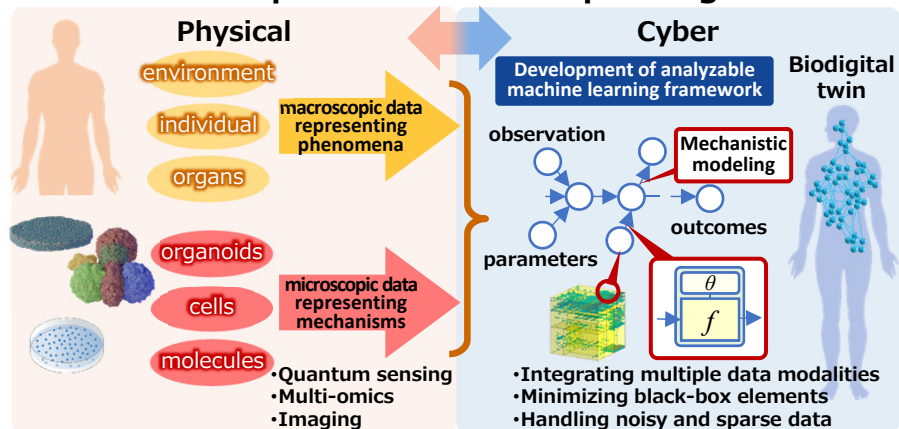
Many of unsolved diseases are caused by complex interactions between genetic and environmental factors. **“How do such complex interactions cause diseases in human body?”** is the key question in biology.

PRIME will solve this question **by developing digital twins of human (biodigital twins)** that reproduce in cyber space the biological phenomena and pathological processes in human organs **to create Human Metaverse Medicine.**

Digital twin: a computer reproduction of real-world object using various data collected from reality

Research

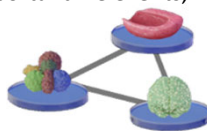
1. Creation of platform to develop biodigital twin



2. Creation of Human Metaverse Medicine

PRIME will elucidate pathogenic mechanisms in human focusing on important life events, i.e., development, reproduction, and aging.

- Elucidation of cause and pathology of 9 diseases associated with eye, liver, brain, heart, and reproductive organs
- Elucidation of metabolic mechanisms through inter-organ network



3. ELSI study in creation of Human Metaverse Medicine

PRIME will conduct research and find solutions for ethical, legal, and social issues.

Identities

- World-class researchers of “human organoid-based biomedical sciences” and “information and mathematical sciences” will be united, along with quantum life sciences and ELSI study.
- “Biodigital twin” of human individuals will be developed.
- Using biodigital twins, Human Metaverse Medicine will be created to elucidate pathological mechanisms of human diseases (esp. common diseases), to predict their onset, progression, and treatment response, and to develop their treatment.
- Information space platform “human metaverse” will be constructed to share biodigital twins with researchers and medical professionals world-wide.
- Human Metaverse Medicine will introduce innovation in current medicine to realize ultra-personalized medicine and healthy society.
- Next generation human resources specialized in both biomedical science and information / mathematical sciences will be fostered.

Collaborations

