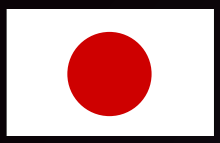

Japan-U.S.

Research Collaboration Symposium Innovating out of COVID-19 -Human Centered Data Integration for a Resilient Society-

Hosted by
the Japan Science and Technology Agency (JST),
Stanford University School of Medicine,
Kyoto Prefectural University, and Nagoya University

November 10 (JST), 2022

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Overview

Introduction

“Japan-U.S. Research Collaboration Symposium: Innovating out of COVID-19 – Human Centered Data Integration for a Resilient Society” was held virtually on November 10 (JST), 2022, through the JST-Stanford Initiative (JSI). The symposium was hosted by the Japan Science and Technology Agency (JST), Stanford University School of Medicine, Nagoya University, and Kyoto Prefectural University.

The symposium provided an opportunity for top scientists from Japan and the United States to discuss the challenges facing cutting-edge science in addressing the COVID-19 pandemic as an opportunity for innovation. It also included a series of pitch talks by young scientists from Japan and the United States, presenting on the results of a series of discussions held prior to the workshop regarding the challenges for creating a future society and next-generation personalized medicine.

Background on the JST–Stanford Initiative (JSI)

The JST-Stanford Initiative (JSI) was launched in 2021 with the aim of creating a foundation for research exchange between Japan and a group of universities, research institutions, and companies on the West Coast of the United States. JST and Stanford University serve as a hub for this activity.

In December 2021, the JST Department of International Affairs and the Department of Anesthesiology at Stanford University signed a “memorandum of understanding” (MOU) regarding research cooperation. Based on the memorandum, the Stanford Laboratory for Drug and Device Development and Regulatory Science along with the JST Washington, D.C. Office have planned and implemented joint symposiums and study groups several times a year through regular weekly planning sessions. In addition to inviting top scientists from Japan and the United States, the JSI invites the stakeholders of the research and development that these scientists are working on to joint symposiums and research meetings, and through the exchange of opinions, hopes to better understand each other's efforts and build relationships of trust.

Starting with the discussion at the JST-Stanford University Joint Symposium "Practical Innovations against COVID-19" held in February 2021, researchers from Nagoya University, Kyoto Prefectural University, and Stanford University have held weekly discussions on research collaboration from May 2021 on the theme of "Innovation for a Society with Resistance to Infectious Diseases". From January to March of 2022, Nagoya University conducted a Japan-U.S. living environment comparison study to identify factors influencing the severity of infectious diseases. Through the accumulation of such concrete research collaborations, the JSI aims to sustain the generation of communities bound by trust and to serve as a foundation of research highway between Japan and the United States.

This effort includes collaboration with various networks owned by JST and Stanford University. Some of these networks include: Kanagawa Prefecture, Keio University, and Kyoto Prefectural University, with whom Stanford University has ongoing collaborations, and with the National Science Foundation (NSF) and the Global Federation of Competitiveness Councils (GFCC), and other organizations with which JST is affiliated. In the future, the JSI plans to continue to invite organizations that support this activity from universities, research institutes, and companies in Japan and the United States, and to develop the JST-Stanford Initiative.

Pre-event “Future Innovators Program”

Prior to the Symposium, the JSI organized 4 sets of webinars & workshops, as well as tutorial sessions and special sessions intended for young scientists, with the support of Stanford University, Nagoya University’s CIBoG (Convolution of Informatics and Biomedical Sciences on Global Alliances) and Nagoya University’s DII Collaborative Graduate Program for Accelerating Innovation in Future Electronics.

Qualified young scientists participating from all over the world have been divided into the following 6 themes to develop proposals for future international collaboration projects and create specific solution proposals in the field of Digital Data, Innovation and Wellness. All of the groups are being mentored by distinguished international experts.

- Digital Twins
- Super Aging
- Web 3.0
- Self-Medication
- Disaster & Health
- Wearable & Digital

Each group presented their proposals for business concepts for future research in a pitch talk format at the symposium.

Symposium

Website: https://www.jst.go.jp/inter/washington/stanford2022/en.html

The symposium was held in-person at Nagoya University and streamed as an online seminar on the Zoom client at the following time:

- Japan: Thursday, November 10, 2022 1:00 pm - 4:00 pm JST
- USA: Wednesday, November 9, 2022 8:00 pm - 11:00 pm PST

Agenda

Table 1: Agenda

Time (JST/PST)	Item
1:00pm-1:15pm/ 8:00-8:15pm	Opening Remarks
1:15-1:40pm/ 8:15-8:40pm	Tone-Setting Remarks • *Hiroshi AMANO, Professor, Nagoya University, 2014 Nobel Laureate in Physics* • *Yasuhiro TSUKAMOTO, President, Kyoto Prefectural University*
1:40-2:00 pm/ 8:40-9:00 pm	Guest Presentation • *Koichi FUKUNAGA, Professor, Keio University School of Medicine*
2:00-2:50 pm/ 9:00-9:50 pm	Keynote Presentations • *Michael SNYDER, Professor, Stanford University School of Medicine* • *Naozumi HASHIMOTO, Professor, Fujita Health University, Department of Respiratory Medicine*
2:50-3:00 pm/ 9:50-10:00 pm	Break
3:00-4:00 pm/ 10:00-11:00 pm	Student Pitch Sessions

Opening Remarks

The workshop began with opening remarks from four distinguished speakers.

Remarks by Seiichi MATSUO, Chancellor of the Tokai National Higher Education and Research System

Professor Matsuo began by thanking the JST for their support to the U.S.-Japan Collaborative Research Symposium, and welcomed all of the professors from Stanford University who traveled to Nagoya University for the conference. He emphasized that the symposium is important for two reasons. First, the program's comparative cohort study is an opportunity to explore cutting-edge tools and new horizons for medicine and healthcare in super-aging societies, based on the concept of "pre-symptomatic" prevention of illness. Second, he noted the importance of the JSI's research programs tackling issues related to diversity and inclusion. He concluded by asking all of the participants to consider how to collaborate to create cutting-edge research.

Remarks by Yasuhiro TSUKAMOTO, President, Kyoto Prefectural University

Professor Tsukamoto briefly introduced himself and expressed his excitement to hear about new ideas from young scientists.

Remarks by Michinari HAMAGUCHI, Counselor to the President, Japan Science and Technology Agency (JST)

Doctor Hamaguchi greeted the participants at the symposium, and provided a brief background on the JST-Stanford Initiative (JSI). He stressed the value of the JSI's activities to build strong, stable partnerships and bonds of trust among the scientific researchers across different countries, especially among the young researchers who will be working in the field for many years to come.

Remarks by Ronald G. PEARL, Professor and Former Chair of Anesthesia Department, Stanford University School of Medicine

Professor Pearl emphasized the value of collaboration to science, and gave several examples of how collaborative research has built up our global understanding of how to combat the COVID-19 virus in record time. He noted that the symposium is important because it will give real insights into the role of genetics and environments in infectious diseases. He concluded by thanking the audience and participants.

Figure 1: Remarks by Organizer's Representatives

From left: Prof. Matsuo, Prof. Tsukamoto, Dr. Hamaguchi and Prof. Pearl.

Tone-Setting Presentations

Two speakers provided brief presentations to set the tone for the symposium's key themes.

DUV LED as a Front-line Tool to Provide Safe and Secure Water

Hiroshi AMANO, Professor, Nagoya University, 2014 Nobel Laureate in Physics

DUV light irradiation in the wavelength from 200-300nm has been proven to have inactivation effects on virus counts in water, however, the precise mechanism behind the effects remains to be elucidated. Doses of DUV can de-activate up to 99.99% of airborne coronaviruses, depending on the wavelength used.

Water purification using UVs is very effective to disinfect water. Conventionally this technology has been used to ensure drinking water in a harsh environment, such as after a disaster or in space. A team at Nagoya University's Institute of Materials and Systems for Sustainability (IMaSS) used this technology to create an air curtain system to protect healthcare workers from infection, and their system is now in use at Nagoya University Hospital.

During the Q&A session, Professor Amano explained that the system can be very small, and that the system is using a new materials-based HEPA filter to purify the airflow. He noted that support from JST and other organizations will be important to reduce the cost of the system.

Figure 2: Professor Amano's Presentation on DUV LED

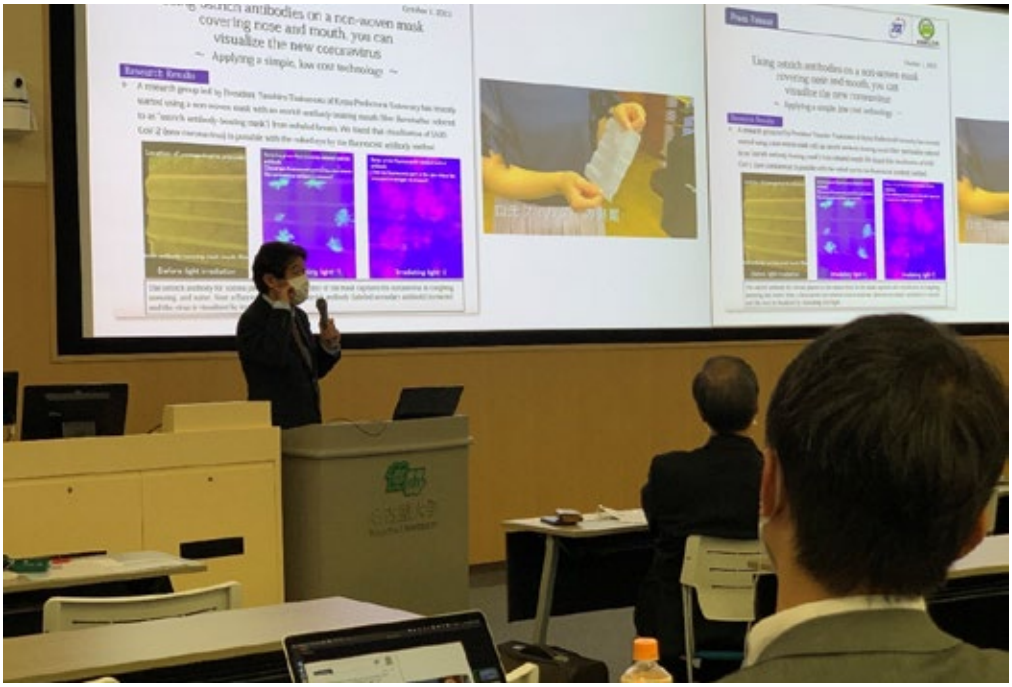
Novel Antibody Science Born from the Pandemic and its Deployment

Yasuhiro TSUKAMOTO, President, Kyoto Prefectural University

Professor Tsukamoto, a veterinarian by training, previously established Ostrich Pharma Co., Ltd., a venture from Kyoto Prefectural University, and developed a mask to prevent new influenza using antibodies extracted from ostrich eggs. In 2009, he received the Minister of Education, Culture, Sports, Science and Technology Award for his achievements in the development of materials for protecting against avian influenza using new technology for mass production of antibodies using ostriches.

He has been engaged in various research projects to create low-cost mass production of antibodies using ostrich eggs, which have benefits such as low costs, resistance to heat and acid, and high pathogen-inactivating activity. His lab has developed ostrich antibodies for many different diseases, including influenza, SARS, Ebola, Zika, and COVID-19. Professor Tsukamoto demonstrated the use of an ostrich antibody filter in a mask to detect and visualize COVID-19. During the Q&A, Professor Tsukamoto explained that the "capture rate" (accuracy) of the COVID-19 detection masks is about 69% for a PCR-positive person. The mask can check for all of the mutant strains of COVID-19, such as Alpha, Delta, and Omicron.

Figure 3: Professor Tsukamoto's Presentation on Ostrich Antibodies for COVID VisualizationCOVID Visualization



Guest Presentation: Japan COVID-19 Task Force Achievement and Future Development

Koichi FUKUNAGA, Professor, Keio University School of Medicine

Professor Fukunaga is in charge of the Japan COVID-19 task force, which was established in May 2020 to fight the pandemic, in cooperation with several hospitals, universities, and research institutions across Japan. The task force established a network of doctors from over 1000 hospitals nationwide to collect patient samples for the largest COVID-19 biorepository in Asia. The clinical information from the hospitals was then analyzed, and the resulting data was managed by participating universities for the analysis of risk-related factors.

Professor Fukunaga then showed some of the findings from the data analysis conducted by the task force, such as the identification of "DOCK2," a notable biomarker for COVID-19 severity in patients. These findings were presented at an international consortium on genomics data. The task force's data will be used in the future for the development of next generation drugs.

In the Q&A session, Professor Fukunaga explained that their research on DOCK2 has not explored whether the biomarkers' effects are specific to COVID-19 or general to respiratory coronaviruses. He noted that funding and other support from JST and NEDO will be valuable to maintain the databank, and that a platform is being created for general access to the data.

Figure 4: Professor Fukunaga's Presentation on Japan's COVID-19 Task Force

Keynote Presentations

Managing Health with Big Data and Wearables

Michael SNYDER, Professor, Stanford University School of Medicine

Professor Snyder is exploring the ways that big data and wearables can help to improve some of the issues with the U.S. healthcare system, which has problems in numerous ways, such as a focus on illness instead of health, too much reactive treatment instead of proactive prevention, and an emphasis on population-based treatments instead of individual-based treatments.

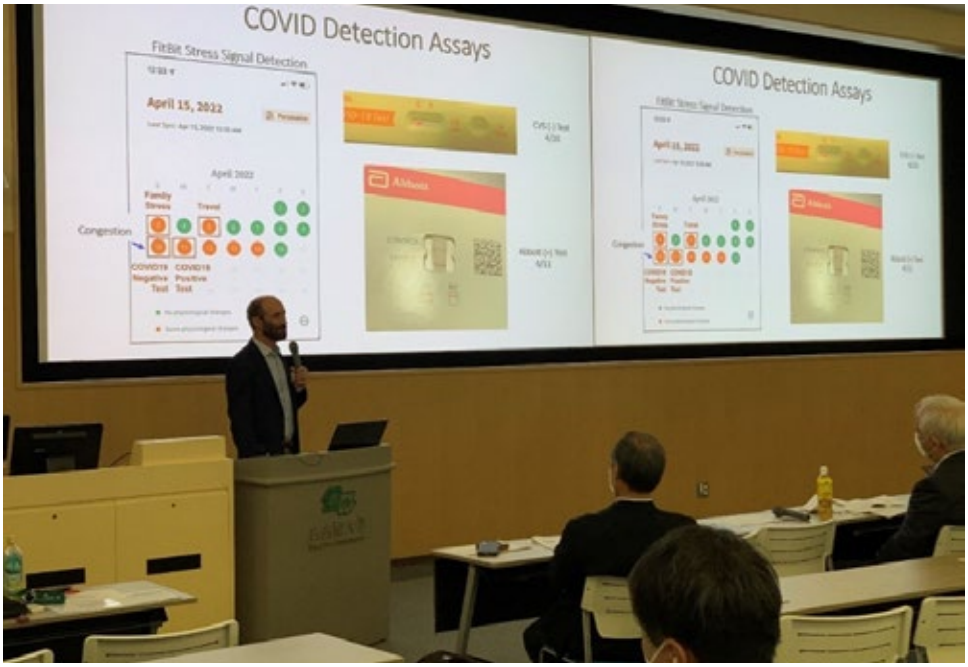
Health is a product of genome and exposome, and many of those variables are increasingly measurable. Stanford is conducting a longitudinal study of 109 individuals to study health in a holistic manner and identify major health concerns early. The study involves thorough personal omics profiling, and also considers personal aging molecules and their pathways.

His lab is also working to explore new uses for wearable health sensors, which are now being worn by about 20% of people in the United States. At the onset of the pandemic, Professor Snyder's lab began working with a cohort of 5,300 participants in an IRB-approved study to explore how wearable sensors can help to detect COVID-19 at an early stage. They found that the sensors detected COVID-19 early about 80% of the time, based on stress warning parameters for physiological changes such as resting heart rate. As one of the participants in the study, Professor Snyder's SensWatch (smartwatch) successfully detected the stress warning signs for COVID-19 a full day before the Abbott COVID Detection Assay registered a positive test result.

Stanford has now built a health dashboard UI platform to allow users to visualize and monitor their wearables' health data at different resolutions. Professor Snyder is now working to spin off several companies that will scale and commercialize this work while he continues this research at his lab.

During the Q&A session, Professor Snyder explained that his team is working to develop more precise algorithms that can tell the difference between a bacterial and viral infection, or between workplace stress and a viral infection, but their work requires much more data. His team is also creating the infrastructure for the devices to send text messages providing real-time alerts when they detect possible infections.

Figure 5: Professor Snyder's SensWatch Detects COVID-19 Case Ahead of the Abbot COVID Detection Assay



Feasibility Study of NaSC and the Expectation for the Personalized Medicare

Naozumi HASHIMOTO, Professor, Fujita Health University, Department of Respiratory Medicine

Professor Hashimoto led the initial feasibility study for the "Japan-U.S. collaborative cohort research to elucidate factors contributing to individual differences in virus responses," also called the Nagoya-Stanford Cohort (NaSC) study, which is a flagship project for cooperative research between JST and Stanford University.

The study will study a cohort of 120 healthy people (a mix of Japanese and Caucasians living in Japan and the San Francisco Bay Area, equally divided among men and women) to collect billions of omics measurements, especially measurements from wearable devices' biosensors. The study will consider health as a product of both genomes and exposomes (the measure of all the exposures of an individual in a lifetime, such as pathogens, stress, exercise, etc.).

Before launching the NaSC study, Professor Hashimoto oversaw a feasibility study to understand the ciritical factors for the study, such as setting up the smartphone and "MyPHD" app to work with biometric data, recruiting the necessary participants, and obtaining grant funds. The cohort selection was designed to explore the risk of fibrotic disease and severe COVID-19.

The study will consider the connection of living locations to information about environmental exposure to variables such as fine particles (PM2.5) in the atmosphere, NO2 (nitrogen dioxide), NO (nitric oxide), temperature, and humidity. In addition, the study will collect participant biodata through “SensWatch,” a wearable device developed by Professor Michael Snyder’s lab at Stanford University. The patient data will be collected every thirty seconds by the devices and will be shared between Nagoya University and Stanford University.

Professor Kinji Ohno at Nagoya University used the data collected to analyze whether microbiome (gut) profiling might reflect the risk of respiratory severity in COVID-19 infection. Professor Koji Sakamoto at Nagoya University Hospital conducted omics RNA-seq analysis of blood cells to study the relationship between the omics data and COVID-19 infections.

The feasibility study identified challenges such as low technology awareness among elderly participants who may not know how to use a smartphone app. The study also found that since the MyPHD app was only in English, it would be necessary to create a Japanese version. They also found that a call center was needed to respond to any questions from participants.

During the Q&A, a member of the audience complimented the study for the idea to use wearable devices to detect oxygen saturation for the early diagnosis of respiratory diseases in vulnerable patients. Dr. Hashimoto responded that one of the reasons that they decided to use the SensWatch device was because it could capture oxygen saturation information

Figure 6: Dr. Hashimoto Presents the Work by Nagoya University Researchers

Student Pitch Contest

The JST-Stanford Initiative has organized a six-week series of webinars, workshops, tutorial sessions and special sessions intended for young scientists in the field of health. The 29 graduate students have been divided into teams to develop ideas for future international collaboration projects and create solution proposals, with support from distinguished mentors.

Each team presented their proposals at the symposium in a "pitch contest," with ten judges scoring the teams on metrics such as 'unique/new,' 'exciting,' 'feasible/concrete,' 'serve public good,' and 'good teamwork.' Their pitches are summarized below.

Digital Twin for Sports Injury Rehabilitation Using Golf as an Example

Brian Sumali, Mona Aboalela, Jessica Pan, Ping-Hao Chang, Yudai Awashima
(Mentor: Prof. Hitonobu Tomoike)

The team proposed a personalized medicine solution that collects patient data from smart devices, sensors, medical records, and social media, and then stores and processes the data to create a digital twin, which is then provided to the user through a simple and intuitive UI. They proposed a subscription model for clients to use their phone to capture their movement when they play golf, and they could then upload their videos to a cloud system for posture analysis.

How Can We Help to Prevent Dementia

Jackey Yu-You Wang, Takashi Uematsu, He Zhang, Yung-Chien Wang
(Mentor: Prof. Chen-en Ko)

The team seeks to improve the quality of life (QOL) for dementia patients and families. They proposed an app that collects data from wearables such as the Oura Ring or the Apple Watch to monitor the user's biodata for warning signs for dementia and provide an early diagnosis, along with suggested help guidelines and training activities for dementia prevention. The data could also be shared with doctors and medical researchers for research to improve the life quality of super-aging societies.

Community-based Self Medication

Hikari Isaji, Isabel Yang, Satoshi Nakano, Hidekazu Takahashi, Toshiki Mori
(Mentor: Mr. Yasuto Yamaguchi)

The team proposed "Pillo+," a small mobile companion robot for elder care. The robot would automatically dispense medicines/supplements or provide reminders to the patient. It could also provide medical support through sharing useful health information, encouraging community-based activities, or providing a terminal for online consultations with healthcare professionals, and could call for help in emergency situations (such as a fall or heart attack).

Prophet Helmet for Zero Sexual Assault

Sawako Furukawa, Satoru Sawada, PeiYang Cai, Chih Yu Chai, Fengchang Lin
(Mentor: Mr. Pavan Ongole)

During a natural disaster such as a hurricane, tsunami or earthquake, people staying in crowded evacuation shelters are at a high risk of sexual assault crimes such as domestic abuse or rape. Many victims have suffered PTSD as a result. The team proposed the "Prophet Helmet," which evacuation shelter staff could wear to assist them in detecting sexual assault symptoms (such as a sudden increase in fear and stress in the area) and predict criminal activity.

Regional Health Using Wearable Devices

Tomoya Watanabe, Gregory Lu, Marie Ohbiki, Nozomi Kawabe, Naoki Kirimura
(Mentor: Prof. Yasue Mitsukura)

The team proposed creating a regional infectious disease risk index based on the data from wearable devices. Their ring-type device would monitor a biomarker (such as temperature or heart rate), which would then be anonymized and sent to a data center to support regional health initiatives, in combination with other data from wastewater and hospitals. Their end goal is to develop a more robust system to quantify, predict, and control the risk of infectious diseases.

BMDAO: Brain Machine Decentralized Autonomous Organization

Kanna Omae, Taiki Fukushima, Yuta Shina, Hinata Goto, Yi Jung Chueh
(Mentor: Mr. Yohei Ichishima)

Virtual reality (VR) technologies have the potential to be used alongside EEG readings to extract information from brain activities. Developing this knowledge could help to improve the reality of VR worlds by enabling increased communication without physical actions. The team proposed a Brain Machine Interface (BMI)-based VR communications tool, along with an open database of EEG data and a reward system for users to share their anonymized EEG data. The organization would rely on Decentralized Autonomous Organization (DAO) concepts to operate on the blockchain, providing high transparency and cost reductions through automated actions.

Figure 7: Group Photo after the Student Pitch Contest

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