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JST to fund 11 projects on COVID-19-related research under the J-RAPID Collaborative Research/Survey Program for Urgent Research framework

JST has decided to award funding to 11 projects for COVID-19 related research under the J-RAPID Collaborative Research/Survey Program for Urgent Research* framework (Appendix 1).

JST launched the J-RAPID call targeting researchers who are currently in collaboration with or anticipate collaboration with foreign-based researchers for non-medical research directly applicable to mitigation of the ongoing COVID-19 outbreak (Appendix 2).

A total of 23 proposals were submitted to the call, out of which 11 were selected for funding following an evaluation by a panel of experts (Appendix 3).

Supported research is ongoing and the support period is scheduled to last until March 2021.

* J-RAPID Collaborative Research/Survey Program for Urgent Research
URL : https://www.jst.go.jp/inter/english/program_e/j-rapid_e/j-rapid.html

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Appendix 1

Abstracts of funded projects

1. Collaboration with the National Science Foundation (NSF), United States

	Project Title	Principal Investigator (Japan-side) Principal Investigator (US-side)	Position and Institution	Abstract of Project
1	Real-time monitoring of novel coronavirus (SARS-CoV-2) infections using wastewater-based epidemiology approach	Haramoto Eiji	Professor, Interdisciplinary Center for River Basin Environment, University of Yamanashi	This study aims to develop a novel real-time surveillance system for the prevalence of COVID-19 through a wastewater-based epidemiology (WBE) approach. Novel coronavirus (SARS-CoV-2) RNA will be detected in raw sewage of wastewater treatment plants, where viruses shed in feces of all infected individuals, including asymptomatic cases, in their service areas are gathered. For this purpose, three specific research activities will be conducted as follows: 1) the development of novel concentration and detection methods for SARS-CoV-2 in raw sewage, 2) the application of the developed methods to detection of SARS-CoV-2 in raw sewage samples of wastewater treatment plants in Japan and other countries in order to elucidate the actual prevalence of the virus in the studied regions, and 3) the evaluation of the applicability of WBE approach to COVID-19 surveillance based on the comparison between the current epidemiological data (numbers of confirmed COVID-19 patients) and concentrations of SARS-CoV-2 in raw
		Kyle Bibby	Associate Professor, Department of Civil and Environmental Engineering and Earth Sciences, University of Notre Dame	

				sewage. The outcomes of this study will contribute greatly to control the spread and recurrence of COVID-19 through a real-time early warning system based on routine monitoring of SARS-CoV-2 in raw sewage.
2	Modeling the effect of comprehensive interventions including several rapid diagnostic tests on COVID-19 transmission	Mizumoto Kenji	Assistant Professor, Graduate School of Advanced Integrated Studies in Human Survivability /Hakubi Center, Kyoto University	Since the novel coronavirus disease (COVID-19) emerged in December 2019 in China, it has rapidly propagated around the world, leading to one of the most significant pandemic events in recent history. The first COVID-19 case in Japan was reported on January 15, and the number of cases reached 16,385 with 771 deaths on May 20, 2020. Capturing COVID-19 transmission dynamics is important to guide the timing and intensity of intervention strategies, but limited PCR testing capacity has made it difficult to record actual numbers of COVID-19 cases in Japan. Several rapid diagnostic tests undergoing approval processes will support uncovering the transmission dynamics, necessitating that the examination of several characteristics of tests including time-dependent sensitivity and specificity. In this proposal, we aim to 1) Capture an epidemic trajectory in Japan given adjustments in testing capacity 2) Guide optimal combination of several tests 3) Guide intervention efforts, such as isolation of infectious individuals, quarantining of suspected contacts, and minimizing contact rates without a complete lock down.
		Gerardo Chowell	Professor, School of Public Health, Georgia State University	

				In object 2), we examine a) time-dependent sensitivity and specificity of the tests, b) time gap between testing and results, c) maximum number of tests administered per day and d) targeted populations. For this purpose, we employ a compartmental transmission model (SEIR model) taking into account aspects of testing along with other constraints (e.g. availability) of the tests. For estimation, we plan to use not only a maximum likelihood estimate, but also the Markov chain Monte Carlo method in a Bayesian framework to capture underlying transmission dynamics.
3	Development of the key reaction and the mechanistic studies toward discovery of new anti-COVID 19 drugs	Niwayama Satomi	Professor, Graduate School of Engineering, Muroran Institute of Technology	Developing drugs against COVID-19 is currently of paramount importance. For example, Remdesivir is a prodrug having a structure similar to a nucleotide able to prohibit the viral RNA polymerase production process, although it comes with some side effects. Similar anti-viral activities with greater potencies and less side effects may be expected from other nucleotide derivatives as well, which may be identified by the synthesis of libraries of various derivatives of nucleotides or nucleosides as well as other compounds having different structures for screening of their anti-COVID-19 activities. In this research, we will develop key reactions that enable efficient production of drug candidates under environmentally benign and practical conditions toward this goal. Water is among the most
		Kendall Houk	Professor, Department of Chemistry and Biochemistry, University of California, Los Angeles	

				environmentally friendly and least expensive solvents. Desymmetrization of symmetric compounds is one of the most cost-effective reactions because the starting symmetric compounds are typically easy to obtain on a large scale from inexpensive sources or are otherwise commercially available at low cost. Therefore, desymmetrization of symmetric compounds mediated by water would make a significant contribution to “green chemistry” and to drug discovery, although distinguishing the identical functional groups in the starting symmetric compounds is considered challenging, and success of such reactions is limited. To this end, we had previously reported highly efficient selective monohydrolyis reactions of symmetric diesters in mainly aqueous media. Therefore, in this research, we will study these selective monohydrolysis reactions and enzymatic monohydrolysis reactions of symmetric diesters from both the synthetic and mechanistic points of view. The mechanistic studies will be carried out in collaboration with Professor Kendall N. Houk, who is a US-based authority on theoretical and computational organic chemistry. Success of this research will contribute not only to discovery of new anti-COVID-19 drugs but also to the field of green chemistry.

4	Development of novel anti- SARS-CoV-2 drug leads from marine organisms	Sakai Ryuichi	Professor, School of Fisheries Sciences, Hokkaido University	We recently assembled an international collaborative team to find anti-flavivirus drug leads from marine organisms (e-ASIA). The team is comprised of a marine natural product chemist (Sakai, Hokkaido University, Japan), a synthetic chemist (Romo, Baylor University, USA), a medicinal chemist (Hull, Baylor University, USA) a RNA biologist (Chimnaronk, Mahidol University, Thailand) and a structural biologist (Tanaka, Tohoku University, Japan). As a team, we developed a drug development pipeline, that will span lead discovery to lead optimization with the goal of developing a unique set of drug candidates rapidly. We are screening anti-flavivirus compounds by a high throughput screening protocol developed by Chimnaronk. We have already assayed 120 small molecules (68 natural products) and found several marine derived compounds that inhibit infection of flavivirus to mammalian cells. These are exciting preliminary results showing great potential for marine-derived natural products as novel anti-flaviviral agent. We therefore propose here to use our marine library to discover anti-SARS-CoV-2 compounds, taking advantage of our unique international collaboration. In this proposal Sakai will collect marine organisms and isolate compounds that inhibit infection of SARS-CoV-2 to mammalian cells. Sakai will also study the mechanism of inhibition to identify molecules with unique modes of action. Romo will utilize his
		Daniel Romo	Schotts Professor of Chemistry, Department of Chemistry and Biochemistry, Baylor University	

				‘pharmacophore-directed retrosynthesis’ approach to quickly validate a hypothesized pharmacophore and identify simplified versions of the initial hit. A collection of 2-3 simplified derivatives, with the highest potency and initial pharmacokinetic properties, in comparison to the initial lead will be tested in animal models for anti-SARS-CoV-2 efficacy.
5	Development of antigen display system using hyperthermophilic archaeal viruses for emergent vaccine production	Mochizuki Tomohiro	Specially-appointed Assistant Professor, Earth-Life Science Institute (ELSI), Tokyo Institute of Technology	This project aims to induce a hyperthermophilic archaeal virus to display short fragments of SARS-CoV-2 spike proteins on its virion surface, intended for application in future emergent vaccine mass production. Among the many obstacles in developing successful immune system defenses against an emergent disease, efficiency in producing antigens both rapidly and abundantly is a key challenge. In conventional methods involving cell cultivation (e.g. *E. coli*, insect, animal, or human cells), contamination becomes a serious concern, especially in the mass production stage. Our new proposed system using hyperthermophilic organisms with an optimal growth temperature of 90 ° C can easily minimize such risk. Recently, we have succeeded in developing a genetic modification system for one of the hyperthermophilic archaeal viruses. In this project, after identifying the amino acid residues of the capsid structural proteins which are located at the surface of the virion particle, we will
		Kenneth Stedman	Professor, Department of Biology, Portland State University	

				modify the capsid protein genes to express external peptides that will be displayed as appendages on the virion surface. Eventually, by using part of the SARS-CoV-2 spike protein (S protein) as this insertion, we hope that the mutated archaeal virus can serve as an antigen for COVID-19 vaccination applications. With a timely and successful research outcome, our system may potentially be utilized against COVID-19 beyond the second half of 2021, at the earliest. Since both the host archaea and the virus can be grown rapidly in very simple media and conditions – only requiring near boiling temperature control – the virus-host system can easily be grown in facilities without stringent aseptic cultivation platforms.

2.Collaboration with UK Research and Innovation (UKRI), UK

	Project Title	Principal Investigator (Japan-side) Principal Investigator (UK-side)	Position and Institution	Abstract of Project
6	Impacts of COVID-19 on the transport and logistics sector and countermeasures	Hayashi Yoshitsugu	Director & Professor, Frontier Research Institute/Center for Sustainable Development and Global Smart City, Chubu University	The COVID-19 pandemic has spread rapidly across the world, resulting in losses of many valuable lives. This has become the biggest challenge to human society since the Spanish Flu in 1918. Now in the 21st century, the whole world is more connected by convenient transport systems and information networks than at any time in history. The transport sector has been deeply affected by the COVID-19 pandemic. On one hand, it unintentionally contributed to the spread of the virus through passenger travel, while the disruption to supply chains undermined economic activities in some sectors. On the other hand, transport is an integral part of solutions to mitigate the impacts of COVID-19, for example through the delivery of humanitarian goods and services and to facilitate resilient supply chains for the recovery phase. This research aims to investigate the following points related to the transport and logistics sector, by interviewing experts and general public globally, in collaboration with the World Conference on Transport Research Society (WCTRS). [1] Impacts: to investigate the
		Greg Marsden	Professor, Institute for Transport Studies, University of Leeds	

				impacts of COVID-19 [2] Preparedness: to investigate in what ways society had prepared for such a pandemic [3] Concurrent pandemic measures: to investigate what measures our society is currently taking to fight against this pandemic [4] Post-pandemic recovery measures: to suggest what our society should do after this pandemic [5] Long-term strategies: to explore how to generalize the findings from the above actions to tackle other public health threats. This research has already started as a voluntary activity together with WCTRS which established a Task Force (all the researchers are involved) in April 2020. With this funding support, we plan to provide more scientifically-sound evidence and feasible policy measures against COVID-19 and future public health pandemics.
7	Investigation of the roles of SARS-CoV-2-encoding genes on the COVID-19 pathogenesis and viral cross-species transmission	Sato Kei	Associate Professor, Institute of Medical Science, The University of Tokyo	As one of the features distinguishing SARS-CoV-2 from its more pathogenic counterpart SARS-CoV, we have revealed the difference on some virus-coding genes. Through interdisciplinary collaboration with a UK research team, we have demonstrated that a SARS-CoV-2-encoding gene is a potent interferon antagonist. Phylogenetic analyses and functional assays further revealed that SARS-CoV-2-related viruses from bats and pangolins also encode genes with strong anti-interferon activity. Through collaboration with the UK

		Massimo Palmarini	Director/Professor, MRC-University of Glasgow Centre for Virus Research	research team, we can investigate more than 50,000 SARS-CoV-2 sequences in the current COVID-19 pandemic. In this project, we collaborate with the UK research team, which is the center for SARS-CoV-2 sequencing analysis in UK, and conduct interdisciplinary research of virology and molecular phylogenetics on SARS-CoV-2/COVID-19. We aim to elucidate the molecular mechanisms of cross-species transmission of coronaviruses and their pathogenicity.
8	National Online Survey of Children's Quality of Life and Health in the COVID-19 Pandemic in Japan (CORONA x CODOMO)	Morisaki Naho	Chief, Department of Social Medicine, National Center for Child Health and Development	Through this joint research between the CORONA x CODOMO project in Japan and the Co-SPACE project run by Dr. Polly Waite, we will conduct follow-up surveys to the already running "National Online Survey of Children's Quality of Life and Health in the COVID-19 Pandemic in Japan" to form a longitudinal study consisting of repeated cross-sectional measures. Through frequent information exchange between the two teams, this project will compare results, share ideas for improvement of questionnaires as well ideas for social implementation of the research findings. This project will not only lead to academic findings of how a pandemic has negative impacts on children and young people's overall health, what support families need, and how this may vary according to situational factors, but will help both countries identify and implement measures which protect children and young people from deteriorating mental health over time in such a crisis.
		Polly Waite	Senior Clinical Research Psychologist, Departments of Experimental Psychology and Psychiatry, University of Oxford	

3. Collaboration with Agence Nationale de la Recherche (ANR), France

Project Title		Principal Investigator (Japan-side) / Principal Investigator (France-side)	Position and Institution	Abstract of Project
9	Paper-Based Sensor Devices for Rapid and Accurate Detection of COVID-19	Minami Tsuyoshi	Associate Professor, Institute of Industrial Science, The University of Tokyo	Polymerase chain reaction (PCR), antigen test, and antibody tests are available for the diagnosis of viral infections. However, due to some remaining problems of the diagnostic methods related to required time, accuracy, and reagent stability (mainly with enzymes), there is currently an urgent need for the development of a new class of diagnostic methods for COVID-19 infections. In this project, we collaborate with a French research group (Principal Investigator: Dr. Anthony Genot) to create paper-based sensor devices (PSD) for rapid and accurate quantification of COVID-19 RNA. The PSD devices can be easily prepared through a printing process, which is a major advantage for the development of user-friendly, low-cost, and disposable devices. The mechanism of COVID-19 RNA detection relies on the specific aggregation of dispersed beads due to the binding of the RNA with complementary DNA, which can be observed as changes in optical properties. The French group will optimize the process of RNA extraction from the virus capsid, and conjugation of the complementary DNA on the dispersed beads. By utilizing their knowledge and
		Anthony Genot	Head of Research, Laboratory for Integrated Micro Mechatronic Systems, French National Centre for Scientific Research (CNRS)	

				materials, we will develop a rapid and accurate quantification method for COVID-19 RNA combining with image processing algorithms and machine learning. Our knowledge will be shared with the French group to boost this collaborative project. The quantitative analyses will also be carried out on PSD devices prepared under the optimal printing and manufacturing conditions. Finally, the PSD devices will be employed for real-sample analyses using samples from the patients infected by COVID-19. The analysis will be carried out in cooperation with the French group. We envision that this project will establish a platform for PSD devices applicable to medical diagnosis.
10	Molecular mechanism for SARS-CoV-2-specific immunological memory formation and maintenance	Murakami Masaaki	Professor, Division of Molecular Psychoimmunology, Institute for Genetic Medicine and Graduate School of Medicine, Hokkaido University	Immunological memory is a unique property of cells for the adaptive immune system mediated by T cells and B cells. Memory T cells and B cell, which are generated during primary immune reaction, can respond more quickly and strongly to infectious agents for eliminating them when they reencounter the same agents. These memory responses are a basis of vaccine strategy. We investigate memory T and B cells, and plasma cells specific for SARS-CoV-2 in samples from COVID-19 patients, patients recovered from the disease, and deceased patients from both Japan and France. The joint research will be carried out to achieve the following five goals: (1) demonstration of the presence of memory T cells and B cells against SARS-CoV-2 in patients;
		Simon Fillatreau	Professor Medical Faculty Universite de Paris Director	

			Immunology, Infectiology and Haematology Dept Necker-Enfants Malades Institute	(2) identification of specific markers for memory T cells and B cells against SARS-CoV-2; (3) analysis of the ethnic differences of the memory T cells and B cells against SARS-CoV-2 between Japan and France; (4) analysis of the correlation of the memory T cells and B cells against SARS-CoV-2 with HLA restriction, age, preexisting diseases, disease severity, and serum inflammatory mediators such as IL-6, IFN-α/β, TNF-α etc.; (5) investigation of the IL-6 amplifier role in the formation and maintenance of memory lymphocytes against SARS-CoV-2. Our research will provide useful information to promote globally the development of effective vaccination methodology and clinical interventions for COVID-19.
11	How public health, hospitals and health professionals have adapted, responded and transformed the disruption caused by the COVID-19 pandemic	Honda Ayako	Professor, Department of Economics, Sophia University	The COVID-19 pandemic has caused serious disruptions to health systems across the world, regardless of a country's socio-economic status or geographical location. In order to better understand the resilience of health systems, this study looks at how hospitals and health professionals at the frontline of the healthcare response have adapted, responded, and transformed the trajectory of the COVID-19 pandemic. The study also examines the attributes of health systems that have facilitated and/or challenged healthcare providers' capacity to maintain their function in the health system during the emergency, and then draw viable policy recommendations for what needs to be done to strengthen health systems resilience
		Valéry Ridde	Research Director, Population and Development Center (CEPED), French National Research Institute for	

			Sustainable Development (IRD)	in preparation for future crises. The case study in Japan will be undertaken with the support of JST and is part of multi-country research project involving Brazil, Canada, China, France and Mali (funded by ANR and CIHR). The larger research project applies a multi-case study approach in which the response of healthcare providers (both organizations and individuals) in the process of transforming the COVID-19 crisis situation is the unit of analysis. The research primarily uses qualitative data and employs a conceptual framework for analysis. A generic study protocol will be used by research teams in six countries to enable cross-country comparison of the case study results and consider the socio-economic, geographical and institutional contexts in the patterns of response to the pandemic. The research will add depth to the global debate on concrete approaches to improving the resilience of health systems. The study in Japan also includes analysis of financing and benefit incidence, which is often used as an indicator of progress towards universal health coverage (UHC). The financing and benefit assessments will be used as baseline measurements to examine the UHC impacts of COVID-19 on the Japanese health system. Further analysis will be undertaken after the pandemic to enable comparison with the baseline analysis.

Appendix 2

Overview of call for proposals

1. About J-RAPID

The J-RAPID* program is dedicated to urgent support for collaborative activities between Japan-based and foreign-based researchers in conducting research related to mitigation of unanticipated events such as natural or anthropogenic disasters and similar areas.

J-RAPID aims to play an initial response role by promptly providing research support before ordinary projects implemented by the national government, academic societies, and others are able to do so.

J-RAPID supports international collaborative projects in collaboration with funding agencies and research institutes in foreign countries.

(*) Initiated by Dear Colleague Letter for New Zealand and Japan dated March 29, 2011 issued by the National Science Foundation (NSF) of the United States, JST launched the original "J-RAPID" call in April 2011.

2. Call for proposals

(1) Proposal field application requirements:
This program welcomes non-medical research related to the prevention and mitigation of effects of the COVID-19 pandemic conducted jointly with researchers supported by eligible foreign funding agencies. Japan-based researchers must either currently collaborate with, or anticipate to collaborate with, researchers based in foreign research institutions supported by eligible foreign funding agencies.

(2) Applicant eligibility (JST side):
Funding is available to researchers affiliated with universities, research institutions, corporations and other eligible entities based in Japan.

(3) Research period:
Six months to one year

(4) Amount of funding (JST):
Up to 6 million yen from JST to the researchers (Japanese team) per project, inclusive of overhead costs (10 percent of direct costs).

(5) Evaluation method:

Based on evaluation by experts

(6) Evaluation Criteria

① Purpose and suitability for the target field of research

The proposed research should be in line with the purpose and conditions of the call.

② Value of outcomes

The proposed research should be promising in terms of its potential value both academically and in terms of its ability to have an impact on real-world issues.

③ Synergy effects from collaboration

The proposed research should be shown to clearly benefit and derive added value from collaboration in terms of achieving its objectives.

④ Suitability of the research plan

The proposed research should have a detailed plan which is suitable in terms of its content, structure and implementation.

⑤ Suitability of principal investigator

The principal investigator should have sufficient expertise and experience to successfully carry out the proposed research for the duration of the research period.

Appendix 3

Evaluation experts list

Experts for the evaluation

Member Name	Position and Institution
AIZAWA Masuo	Professor Emeritus, Tokyo Institute of Technology
IWAMOTO Aikichi	Director, Japan Agency for Medical Research and Development
KOHARA Satoshi	CEO, Ecotribute., Inc.
TANAKA Yuzuru	Professor Emeritus, Hokkaido University
DOI Miwako	Auditor, National Institute of Information and Communications Technology