Mobilizing Science, Technology and Innovation for the Post-COVID Era in Japan and Beyond

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<Humans and Infectious Diseases>

The relationship between Humans and infectious diseases has a long history. Infectious diseases have claimed many lives throughout eras, such as the plague in medieval Europe and the Spanish flu pandemic of 1918. On the other hand, means of preventing and treating infectious diseases advanced dramatically from the 18th century onward due to the development of vaccines and the discovery of antibiotics. In 1980, the World Health Organization (WHO) declared smallpox eradicated, which had the consequence of removing infectious disease control from the policy priority list. However, infectious diseases have, in fact, subsequently evolved into an even greater threat, exemplified by the emergence of acquired immunodeficiency syndrome (AIDS), and the global spread of diseases such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and new influenza strains.

The outbreak of the new coronavirus disease (COVID-19) has hit our economic and social systems, sounding a warning to the comfortable daily lives we have thus far taken for granted, and forcing us to rethink our values. The relationship between policymaking and science has had a significant impact on developments during the pandemic, as humanity has striven to find optimal solutions that balance the sometimes conflicting demands of preventing the spread of infection while maintaining economic and social activity.

As most infectious diseases are caused by pathogens that are transmitted to humans through wild animals or livestock, the concept of zoonosis has become a foundation of infectious disease theory. In addition, the concept of One Health has been advocated in recent years. This approach takes a holistic view of human health, arguing that humans are but one component of the global ecosystem and that conservation of the ecosystem can only be achieved when both humans and animals are healthy.

<The Status of COVID-19 in Japan>

Japan has thus far experienced infection peaks in three separate waves, with the government twice declaring a State of Emergency, in April 2020 and January 2021. From the outset, the Japanese government has asked citizens to avoid "closed spaces with poor ventilation," "crowded places with many people nearby," and "close-contact settings such as close-range conversations," and has urged a change in behavior at the individual level,

including encouraging people to wear face masks and wash or sanitize their hands. The government has also called for public cooperation in promoting teleworking, refraining from non-urgent outings, and requesting bars and restaurants to shorten their opening hours. However, with an increasing number of infected patients putting a strain on the ability of medical institutions to accommodate them, in February this year the law was revised to further enhance the effectiveness of infection prevention measures and to stipulate the support provided to businesses and local authorities.

It is stipulated that when declaring or lifting a State of Emergency, the government will make a comprehensive judgement based on monitoring of objective indicators related to the status of infected persons and medical institutions. In doing so, it is essential to consult the views of experts with advanced knowledge and to ensure close communication with the heads of local governments.

<Shifting to a Data-driven Society>

When making decisions that will impact society as a whole, the advanced use of information and communication technology (ICT) is extremely effective in refining decision-making based on data, accurately assessing the impact of behavioral changes, and utilizing big data. In particular, in the efforts to prevent the spread of infection, the deployment of data analytics would enable us to detect the infection spread in advance and to better understand the characteristics and propagation mechanisms of viruses whose properties are yet unknown.

For example, numerical simulations of viral spread conducted by RIKEN[1] using the *Fugaku* supercomputer have enabled researchers to visualize how differences in building shape, seating arrangements, wearing of masks and protective equipment, and ventilation methods play a role in the spreading of viruses. Visualizing the dispersal and spread of the virus helps control the spread of infection by allowing citizens and governments to obtain a better understanding of behavioral patterns which can reduce the infection rate.

On the other hand, from a bioethics perspective the vast amount of data accumulated by medical institutions and local governments requires special treatment as personal information when handling. In order to consolidate data on infection status and genome analysis from across Japan in a consistent manner, and to promote broad-ranging application of this data while at the same time taking due care to protect personal information, there are a number of issues that must be resolved. In addition, when making future predictions regarding infection spread, calculation results may differ significantly depending on the model used and the way various parameters which form the basis of the calculation. When promoting the use of data science to design society, the choice of a scenario among the range of available ones, will ultimately rely on a consensus considering multiple social factors.

<Testing and Diagnosis>

The first step that must be taken when establishing countermeasures against infectious diseases is to identify infected persons and the spread of infection. Polymerase chain reaction (PCR) testing is considered the most effective way of identifying COVID-19 infection in individuals, and large-scale PCR testing is generally regarded as essential in

order to control the spread of infection.

PCR testing in Japan has focused on controlling infection clusters, through regional public health centers working to control the spread of infection by concentrating on tracing the infection route and identifying close contacts. However, as community transmission increased, primarily in urban areas, this basic policy was revised in March this year to expand the scope of PCR testing to include unspecified asymptomatic people in order to detect signs of a resurgence in the infection spread as quickly as possible.

Meanwhile, a number of mutated strains of the novel coronavirus are beginning to spread across a wide range of regions. With some of these mutant strains confirmed to be highly infectious, in addition to implementing thorough border measures such as airport testing and quarantine for those entering the country, it is important to expand systems for analyzing the entire viral genome in order to accurately identify community transmission, and to develop test methods for rapidly detecting mutant strains.

<Vaccination>

It goes without saying that the development and rollout of vaccines is critical in order to prevent the spread of COVID-19. Although there is a pressing need to expedite the vaccine development and approval process, any vaccine deployed must also be extremely safe, as these will be administered not only to healthy individuals free of infections but also to those with underlying conditions.

While supporting the research and development of domestically-produced vaccines, Japan has also concluded contracts or basic agreements for vaccine supply with three pharmaceutical companies abroad. The first vaccine was submitted for approval in December last year and approved in February this year. The rollout of the vaccine has started with healthcare workers, with vaccination of the elderly scheduled to begin in April. Vaccines from the remaining two companies were respectively submitted for approval in February and March this year.

When deploying vaccines, thorough, evidence-based communication is essential in order to allay the public's concerns regarding their safety and effectiveness. In particular, addressing the public's doubts and concerns regarding viral mutations and individual differences in immune function will help instill a sense of security and promote societal acceptance of the accomplishments of cutting-edge science and technology.

<International Cooperation>

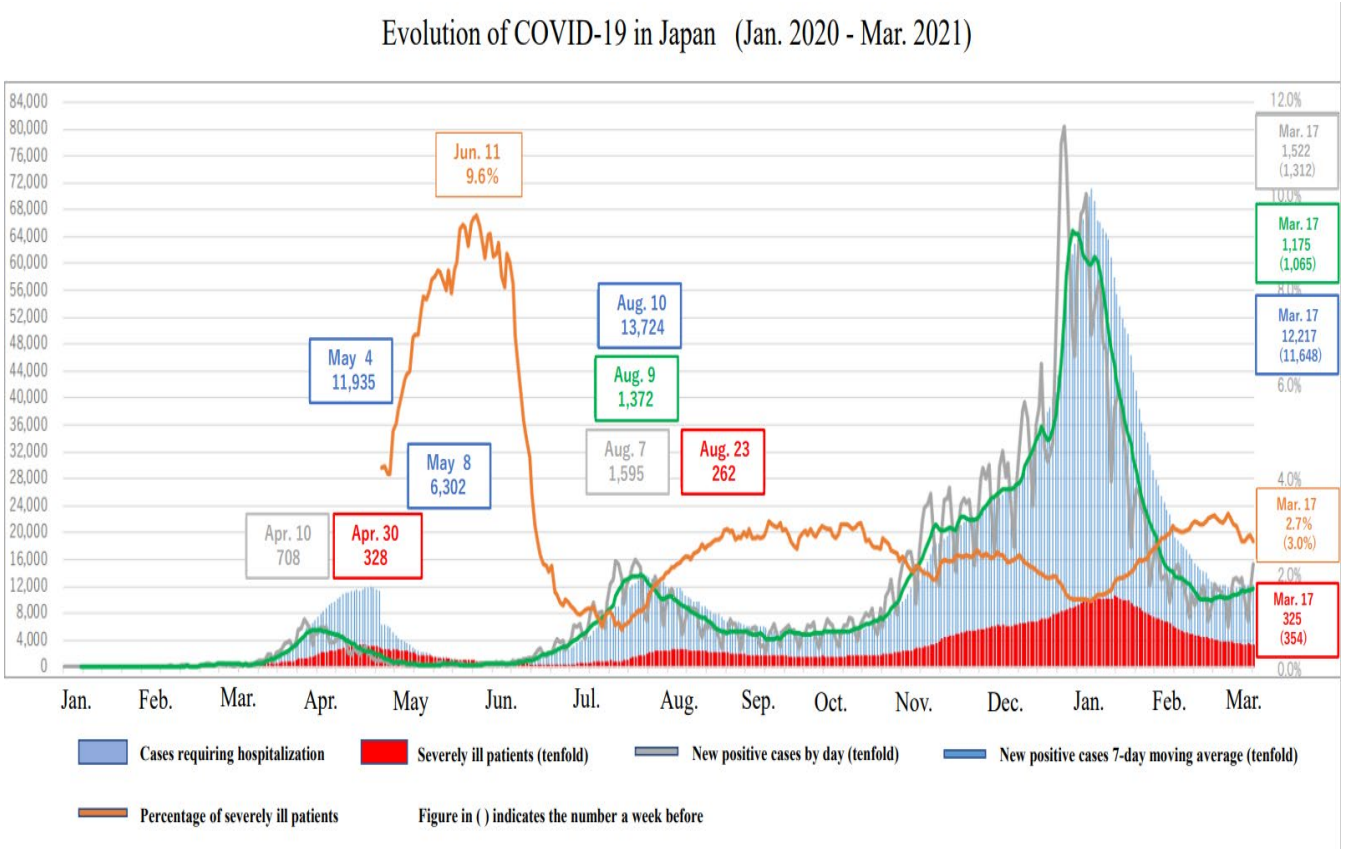
Controlling infectious diseases requires the collective wisdom of the global community, and Japanese researchers and other collaborators are utilizing international networks to help generate global commons. The output from these collaborative efforts has been used to provide scientific advice to policymakers and other stakeholder in a range of countries via forums such as the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R)[2], and the World Health Organization (WHO) R&D Blueprint[3] for action to prevent epidemics. Furthermore, the Coalition for Epidemic Preparedness Innovation (CEPI)[4] was launched as a public-private partnership at the World Economic Forum in Davos in 2017 with the aim of establishing a mechanism (World RePORT)[5] for

sharing data from research and development findings to allow rapid action to be taken on a global scale.

GAVI, the Vaccine Alliance, has launched COVAX Facility: COVID-19 Vaccine Global Access Facility[6] to distribute vaccines broadly with the aim of reducing disparities between countries and regions. Around 190 countries have announced their participation in the scheme. By the end of 2021, the program aims not only to provide two billion doses of safe and effective COVID-19 vaccines that have been approved by regulatory authorities or pre-approved by WHO, but also to achieve equitable vaccine distribution regardless of income level among vulnerable populations, which comprise 20% of participant countries. Japan is also leading the formation of this framework, and has announced a 200 million US dollar contribution.

<Challenges and Future Outlook>

Circumstances surrounding the spread of COVID-19 are closely related to a range of political, social, and cultural factors, each of which will have a significant impact on future developments. If we can rapidly implement comprehensive measures to overcome the crisis, while using the opportunity to rethink our fundamental systems, new prospects for the future will emerge. In particular, we need to attach much value to the establishment of trusting relationship among the policymakers and scientists, as well as human resource development. If we are to turn this global crisis into a leap forward to a new tomorrow, cross-border collaboration and a strong will to challenge the unknown will be of paramount importance. It is essential our current experience is passed on to future generations as valuable lessons, and used to develop economic and social systems that are capable of learning and evolving.



(Novel Coronavirus Response Headquarters：March 18, 2021)

*1 Domestic cases excluding those returning from overseas on charter flights. From May 8, 2020, the data source was changed from figures collated from individual data obtained by the Ministry of Health, Labor and Welfare, to figures collated from data published by local governments on their websites.

*2 The ratio of severely ill patients is calculated from May 8, 2020, when the collation method was changed. The ratio of severely ill patients is defined as the percentage of severely ill patients among cases requiring hospitalization, etc.

*3 Care is required when making comparisons as the scale for patients requiring hospitalization, etc. differs from that for severely ill patients and new positive cases (the number of new positive cases and severely ill patients has been magnified tenfold).

*4 In some prefectures, the number of severely ill patients is calculated using published figures that have been collated according to the prefecture's independent standards, and does not include patients who need to be managed in intensive care units (ICUs), etc.

<References>

1. Research related to COVID-19 : RIKEN
   https://www.riken.jp/en/covid-19-rd/

2. GloPID-R：Global Research Collaboration for Infectious Disease Preparedness
   https://www.glopid-r.org/

3. An R&D Blueprint for Action to Prevent Epidemics
   https://www.who.int/publications/m/item/an-r-d-blueprint-for-action-to-prevent-epidemic

4. CEPI：The Coalition for Epidemic Preparedness Innovation
   https://cepi.net/

5. World RePORT
   https://worldreport.nih.gov/app/#!/

6. More than 150 countries engaged in COVID-19 vaccine global access facility
   https://www.who.int/news/item/15-07-2020-more-than-150-countries-engaged-in-covid-19-vaccine-global-access-facility