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Dr Jeong-Sun Seo, chairman of Macrogen & president of the Korea Biotechnology Industry Organization (

KoreaBIO), explains the basis for Korea's success in combating the spread of COVID-19, casts light on the future role of precision medicine, and the current hurdles impeding its widespread adoption.

What is your assessment of Korea's response to the outbreak of COVID-19?

Korea has been widely praised for its response to COVID-19. For more than 60 years, Korea has had a well-established medical system and today we have over 100,000 medical doctors. Around five years ago, we suffered from the MERS (Middle East Respiratory Syndrome) pandemic, another coronavirus. We also faced SARS (Severe Acute Respiratory Syndrome) in the early 2000s. This made us prepare for another coronavirus outbreak. As a result, our hospitals and medical professionals have been well trained in handling coronavirus epidemics. Our strategy has been to test, trace, and isolate.

In contrast to Western nations, there are few objections to wearing masks in public, as it is part of the culture in Asia. Furthermore, using IT and credit cards, the Korean authorities were able to trace the movements of those infected very effectively. These factors have been the backbone to our effective response.

The pandemic, while tragic, has provided Korean bio-ventures with opportunities to develop and mature. Bio-ventures acted very quickly and have developed many testing kits, which are now also being exported abroad. The response of Korean bio-ventures in the face of the COVID-19 pandemic has been analogous to its response during the MERS outbreak, but this time at a much accelerated pace.

A further unforeseen consequence of the pandemic is an acceleration of the medical sector towards industry 4.0. The crisis has revealed the shortcomings in the system and drawn attention to the need for reforms. Deferring and kicking changes into the long grass are no longer viable options.

How is the importance and scope of precision medicine developing within Korea?

Both Korea and the rest of the developed world face the challenge of an ageing population which is adding further pressure to funding healthcare. The US government spent almost 18.9 percent of its budget on healthcare alone in 2019. Looking to the future, it is unsustainable to continue increasing healthcare expenditure. As a result, both in Korea and abroad, we must control healthcare costs.

Through precision medicine, we can receive lots of data, be it genomic data or EMR (electronic medical records). Korean hospitals are succeeding in generating EMR systems. However, there are still regulations which tie their hands; in the past patients' EMR could not be used outside of the hospital. At the start of 2020, the key data privacy statutes, including the Personal Information Protection Act was relaxed to allow pseudonymized information to be used (without the need for the individuals' consent) for scientific research or public record-keeping or business purposes, such as commercial market research

Korean companies, such as Macrogen, possess very good technology to analyse genome. Combining genomic data with EMR data, healthcare and life information and the already strong IT technology in Korea offers precision medicine a good chance of success.

Precision medicine will not only aid the cost of treatments but also drug discovery. Using AI to screen big data, the amount of money required to develop new drugs could be slashed. Big pharma previously wanted to develop blockbuster drugs, but have modified their strategy, exploring targeted therapies, based on specific genes. This is especially pertinent in the field of oncology. This development requires screening vast amounts of patients for mutations and will necessitate

an abundance of genomic data.

What do you view as some of the main challenges in advancing precision medicine and genomic sequencing?

Although the cost of collecting genomic data has fallen over time, it is still around USD 600 per individual. Collecting a sufficient sample of data, say of 100,000 people, would require USD 80 million – a significant investment that is beyond the reach of most private institutions. While the Korean government has a goal of collecting the genomic data of one million patients. Only through government assistance could a medium-sized enterprise successfully collect adequate samples of genomic data.

Last year, Macrogen published almost 1700 sets of Asian genome data, which has been performed through GenomeAsia 100K Initiative, an international consortium. This is a large sample and was well received by researchers. We hope to reach the genome data of 100,000 Asians in the near future. To share this data requires a large data server. Other companies with smaller servers lack the capacity to analyse large genome sequencing. To facilitate collaboration, I believe that we should use a cloud server.

Some believe that the responsibility to develop these tools should be with the public sector. While I do not disagree in principle, the reality is that procedures within the public sector are often excessively bureaucratic, making progress too slow. Furthermore, the government lacks the expertise required for the project. In my view, the private sector should be given the task, under strict guidelines and support from the government. This strikes a balance between speed, innovation, and making the project mutually beneficial for society as a whole.

One concern regarding the use of data for drug development is that most genomic reference data is mainly based on Caucasian patients. How can Macrogen help to address this issue?

88 percent of patients enrolled in clinical trials in the USA are Caucasians. While this trend is now slowly changing, with a greater diversity of patients, there remains some way to go. This composition is understandable, given that the USA and Europe, with Caucasian majority populations, comprise 90 percent of the drug market.

If we consider the number of Asians, it is 4.5 billion. Many of the Asian countries are not wealthy. Nonetheless, developing countries need healthcare and better treatments. Moreover, within the rapidly developing Asian powerhouse nations, such as China and India, there is a rise in chronic diseases, such as diabetes and hypertension. This will bring a rapid rise in demand for effective high-quality health care. Hence, Macrogen wants to focus on Asian precision medicine. In 2016, we published a Nature paper displaying the characteristics of Asian genomic data, which has helped to build our reputation in this area of study.

How are bio-ventures performing in terms of scientific advancements and attracting foreign capital?

The bioindustry in Korea is flourishing, with many opportunities to gain investment and develop effective treatments. For example, SK recently received approval from the FDA, which is a very good indication of the success of Korean pharma.

The capital investors are particularly focused on new drug development companies. Developing a new drug is not easy, and many companies fail to even make it to the clinical phase. This can make it a risky investment. Nonetheless, they are using open innovation, and it appears to be proving successful, continuing to attract capital investment.

Where do you see the future of Macrogen in the next 5 years?

I think our future trajectory is very clear. We will move further towards collecting big data in the area of Asian genomic information with AI. The most important element needed to realize precision medicine is the gathering of big data. First, we conduct various genome research projects in-house or in collaboration with global medical institutions/research centres. Also, we have published 16 papers in the world-leading scientific journal Nature and its sister journals and three papers with Asian genome data.

Now, Macrogen is getting ready for a second transition from a technology-oriented company to a customer-oriented company. We have solidified its position in the research market not only as a service provider but also as an advisor and research partner through analysis technology. Based on the experience, know-how, and technology of genomic analysis services acquired through research, a meaningful database can be built in all business areas for clinical and general use.

Macrogen is also going to move into the field of microbiomes. This presents a very promising area of study in the future and will complement genomic research. I see it as a blend of genomic information and microbiology. Increasing the breadth of our knowledge vis a vis the microbiome will play a critical role in future treatments, particularly for illnesses of the brain and digestive system. Last year, we acquired all the assets of uBiome, which was the top microbiome company in the United States. It’s 246 patents, 300,000 microbiome data sets and laboratory equipment in San Francisco, etc. We have already begun collecting microbiome data and are accumulating further data at an encouraging rate.

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