A team of researchers from A*STAR’s Genome Institute of Singapore (GIS) and Institute of Bioengineering and Bioimaging (IBB), together with the National University of Singapore Yong Loo Lin School of Medicine (NUS Medicine), was awarded a contract from the prestigious Wellcome Leap R3 Programme to build the next generation of mRNA technology.

The R3 programme has two goals: one, to increase exponentially the number of biologic products that can be designed, developed, and produced every year, reducing their costs and increasing equitable access; and two, to create a self-sustaining network of manufacturing facilities providing globally distributed, state-of-the-art surge capacity to meet future pandemic needs. The research will help to champion the team’s fight against COVID-19 and other pandemics in the future. The Singapore team is the only awardee from Asia, out of 17 teams worldwide to be awarded the contract this year.

The recent development of mRNA vaccines has revolutionised our ability to protect against COVID-19 viruses, and opened the possibility of vaccinating us broadly from additional diseases including other viral, bacterial infections, and even cancer. While highly effective, current mRNA vaccine designs carry several drawbacks, such as the need for low temperatures for transport and storage; the need for high doses to be injected (30 to 100μg/dose); and high costs.

This project aims to address some of these shortcomings. Dr Wan Yue’s lab has been studying RNA, and developing new technologies to study different aspects of RNA in disease and biological systems. In this research, her lab aims to leverage its expertise in RNA to come up with better designs for mRNA vaccines. The team is developing circular RNA versions of the vaccine, which involves increasing and stabilising the amount of proteins produced. This would allow the dose to be reduced, in turn lowering the cost of the vaccine.

Dr Wan, Group Leader of Laboratory of RNA Genomics and Structure, and Associate Director of Epigenetic and Epitranscriptomic Systems at GIS, said, “Understanding the basic biology of RNA is key to our ability to use it as therapeutics. Our team’s work will deepen the understanding of RNA and its ability to be delivered into human cells, enhancing its promise as medicine towards infectious diseases”.

Dr Yang Yi Yan, covering Executive Director, IBB, contributes his expertise in biodegradable nanoparticles-based nucleic acid delivery to enable delivery of RNA into the body. Dr Yang said, “Safe and effective delivery is the key to successful clinical applications of nucleic acid therapeutics. In this work, IBB will make lipid nanoparticles with controlled size and surface functionality so that they can be used to deliver the novel RNA vaccines effectively and safely to lymph nodes and immune cells.”

Also part of the team are Associate Professor Sylvia Alonso, Group Leader and Co-Director of the Infectious Diseases Translational Research Programme at NUS Yong Loo Lin School of Medicine, who will support the team with her vaccinology expertise; and Dr Kevin White, Senior Group Leader, Laboratory of Nucleic Acid Therapeutics, GIS, who is also working on developing stable, low-dose, and cost-effective strategies for generating RNA vaccines.

Prof Patrick Tan, Executive Director of GIS, said, “Singapore is deeply involved in the global effort to develop RNA vaccines to fight both current and future pandemics. Through team effort across various institutes, we hope to develop low cost, effective vaccines that do not need to be injected into the body. This is part of our GIS journey in developing world-class nucleic acid therapeutics capabilities in Singapore to build a fast and flexible system in our fight against different diseases.”