LEADING THE WAY: HOW SAUDI ARABIA IS PIONEERING RESEARCH AMONG GLOBAL PARTNERS

Saudi-led initiatives and collaborative efforts across the Kingdom and with international entities have cemented the nation's role in vaccine research.

The COVID-19 pandemic caught most countries by surprise as they all worked to ramp up their vaccine research and production capacity to try to bring it under control. The research infrastructure that Saudi Arabia has been building up over the past few years has positioned it well to tackle the challenge along with its global partners.

Coinciding with Riyadh's 2020 presidency of the G20, KAIMRC held a session during its Annual Forum on the 'Saudi Academic Efforts for COVID-19 Sciences and Vaccines'. The session was an opportunity to showcase research output from the Kingdom and how it has helped develop one of the vaccines to combat SARS-CoV-2.

Chaired by Dr. Majed Aljeraisy, chairman of KAIMRC's research office and director of clinical trials services, the session featured talks by five distinguished researchers, each with their own stories of challenges and successes.

Since its discovery in camels in Saudi Arabia in 2012, Saudi researchers have focused on understanding the virus causing MERS better, hoping to eventually develop a vaccine. Dr. Naif Alharbi, director of the vaccine development unit at KAIMRC, spoke about the development of a MERS-CoV vaccine, tracing the path from lab bench to camel and human trials in the global effort to find a vaccine since the outbreak of MERS.

"After the international experts' meetings and workshops in Riyadh in 2017 and in Geneva in 2018, the WHO R&D blueprint included MERS-CoV as a priority," says Alharbi, who is a co-lead in the pandemic preparedness unit at the G20 Saudi secretariat.

Alharbi went on to explain that from 2016 to 2019, the University of Oxford collaborated with several research institutes in Saudi Arabia to set up a camel research farm where scores of camels were given vaccines and monitored for antibody production. The researchers' final report, published in *Scientific Reports* in 2019, showed that 90 percent of camels in the Kingdom have pre-existing anti-MERS immunity that does not protect from re-infection. The researchers finally zeroed in on the ChAdOx1 MERS, a vaccine that induced higher antibody levels with pre-existing immunity, confirming the vaccine's efficacy against the coronavirus.

The first-ever in-human vaccine trial was administered in the Kingdom in December 2019 under strict regulatory supervision. "The plan was to do the first phase in the UK, and that was completed and published, followed by another phase in Saudi Arabia. When the COVID-19 pandemic happened, we were ready for it because that is what these kinds of organisations are set up for," Alharbi explained, adding that the work on the ChAdOx1 MERS vaccine helped "set the stage for developing a vaccine for COVID-19." The University of Oxford has reused the ChAdOx1 vector developed for this vaccine in the new ChAdOx1 nCoV-19 vaccine, which is one of the first vaccines approved for SARS-CoV-2 and is already being administered to millions around the world.

Taking the stage afterwards, Dr. Abdullah Algaisi, assistant professor of virology and vaccinology, University of Jazan, and visiting professor at University of Texas Medical Branch, spoke about the development of in-house ELISA tests to detect SARS-CoV-2 antibodies and of a spike pseudovirus that can help

evaluate neutralizing antibodies to investigate antibody responses in a cohort of COVID-19 patients.

"The development of serological assays is part of a huge collaboration to combat the pandemic," explained Algaisi. Currently, both assays are being used to evaluate several SARS-CoV-2 vaccine candidates, as well as in seroprevalence studies in multiple cities in the Kingdom.

Algaisi's work has helped inform COVID treatment, with data showing that patients "can generate high levels of antibody responses that might last for a long period despite their disease severity," he noted. "Importantly, significantly higher levels of antibodies were observed during the acute phase of the disease in severely ill cases, suggesting they could be helpful prognostic markers of COVID-19."

Dr. Anwar Hashem's research has also helped inform COVID treatment. The deputy director and associate professor of immunology at the King Fahad Medical Research Center (KFMRC) in King Abdulaziz University spoke about his research group's efforts to build capacity both at his university and in the country to ramp up vaccine research.

"We already had established platforms in our lab that we utilised right away at the start of the pandemic. We looked at the published sequences and developed a consistent codon-optimised protein from SARS-CoV-2 in which we also played with the secretion levels to enhance production. We then synthesised that synthetic sequence and cloned it for clinical use," explained Hashem, whose international partners included Health Canada and Health Research Centre in Ottawa. The team then tested immunogenicity in animal models and found that vaccinated mice built up antibodies within two weeks of the second dose and their auto-immune response was significantly enhanced.

Also speaking at the session was Dr. Iman Almansour, assistant professor at the department of epidemic diseases research at Imam Abdulrahman Bin Faisal University, who assessed newly developed pDNA vaccines for COVID-19. "There is a global demand for the development and deployment of a prophylactic vaccine that is safe and efficacious. pDNA vaccines possess numerous features that are ideal in a pandemic situation," noted Almansour whose work has also included the creation of a comprehensive online genetic and proteomic research database for SARS-CoV-2 and MERS-CoV. Powered by in-house bioinformatics analysis tools, the database provides a user-friendly interface for customised search analyses by specific virus, date and country.

Rounding off the session was Dr. Mashal Alshazi, assistant professor of pharmaceutical biotechnology at King Saud University, who discussed the development of an mRNA-based vaccine candidate against COVID-19. Working with Baylor College of Medicine, Alshazi's team chose an mRNA approach for the multiple advantages it provides in vaccine development.

"[With mRNA platforms], the production and purification process can be standardised, avoiding the need for costly product-specific production and purification steps. This means the development time for new vaccines can be dramatically reduced, which allows for the rapid testing of more vaccine candidates by high-throughput screening," Alshazi explained. ■

KAIMRC's efforts to transfer basic research to tangible products are in line with Saudi Arabia's Vision 2030.