‘Living’ lab models by NUS team could make developing treatments safer, faster

NUS Dentistry associate professor Vinicius Rosa, who leads the six-member team that developed “living” laboratory models that can change over time, in his lab at the National University Centre for Oral Health Singapore. Prof Rosa said that the innovation has the potential to revolutionise the medical sector. ST PHOTO: BRIAN TEO

They use AI to design biomaterials to more accurately replicate conditions in the body

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While the process of developing treatments for diseases typically involves testing drugs on cells in petri dishes, the stiff, sterile plastic of such laboratory equipment cannot accurately replicate conditions within the human body.

Now, researchers from the National University of Singapore’s Faculty of Dentistry (NUS Dentistry) have developed “living” laboratory models that can change over time, just like real human tissue.

This could eventually make the development of treatments cheaper, safer and more effective, as well as allow them to reach patients more quickly.

The method employs advanced hydrogel-based systems – soft materials that mimic human tissue.

Artificial intelligence is used to design these biomaterials around how cells are expected to behave. This allows scientists to study treatments in dynamic, evolving environments – for example, how inflamed tissue becomes more acidic over several days and responds differently to treatment at each stage.

In a statement, NUS Dentistry said this tackles a longstanding issue in biomedical research – that tests are often conducted in overly simplified laboratory models that do not reflect how human tissue actually behaves.

“These traditional systems often fail to predict real-life outcomes, contributing to lengthy development cycles and continued reliance on animal testing,” the faculty said.

Given how more than 60 per cent of the human body comprises water, water-rich hydrogels can more accurately replicate conditions in the body, NUS Dentistry associate professor Vinicius Rosa told The Straits Times.

“We are not petri dishes,” said Prof Rosa, who leads the six-member team conducting the research.

He said that their research into hydrogels for such purposes has progressed in stages since 2015.

Prof Rosa added that AI models – developed in-house and based on real-world data – help determine the exact composition of materials in the hydrogel.

This allows the biomaterials to be designed around how cells are expected to behave, allowing scientists to study treatments across various conditions and demographics, as well as in dynamic environments.

After production, the biomaterials are tested for a range of characteristics, including strength and flexibility, at the NUS Dentistry labs at the National University Centre for Oral Health Singapore building in Kent Ridge.

In March, Prof Rosa, who is originally from Brazil, was given the IADR Innovation in Oral Care Award by the International Association for Dental, Oral and Craniofacial Research (IADR) and consumer healthcare company Haleon.

Presented during IADR’s 104th general session in San Diego in the US, the award recognises bold, high-impact innovations with strong potential to improve oral health at the population level.

Prof Rosa was among three winners who were awarded US$50,000 (S$64,000) each to advance oral care programmes via the development of innovative compounds, biomaterials or devices that can eventually be used for public health.

NUS Dentistry said: “This recognition highlights Singapore’s growing role as a hub for cutting-edge biomedical innovation with global relevance.”

The implications of the technology go beyond dentistry, Prof Rosa said.

Though initially trialled on dental pulp – the innermost layer in teeth, comprising connective tissue, nerves and blood vessels – the method can be used to construct hydrogels that replicate other tissues in the body as well.

“We can expand to cartilage, we can expand to gum, we can expand to bone,” Prof Rosa said.

Once the technology is perfected, the team will study its use in replicating cells in cancer patients, he added. He said companies have already expressed interest in exploring its commercial applications.

The innovation has the potential to revolutionise the medical sector, added Prof Rosa. “I think the field will see a transformation like we have never seen, and I think we will be a part of that.”

Hydrogels are increasingly being explored for a variety of uses. In August 2025, researchers from several institutions, including Hokkaido University and Shenzhen University, published a study in the journal Nature demonstrating their findings on a new class of super-adhesive hydrogels that retain their stickiness, even underwater.

These biomaterials could be used for deep-sea robots, or as surgical glue for medical procedures, they said.

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