mRNA technology for vaccines and more: An Ars Frontiers recap



Enlarge / On May 22, John Timmer (left) moderated a panel featuring Karin Bok (center) and Nathaniel Wang (right) for the Ars Frontiers 2023 session titled, “Beyond COVID: What Does mRNA Technology Mean for Disease Treatment?”
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The world of biomedicine has developed a lot of technology that seems a small step removed from science fiction, but the public isn’t aware of much of it. mRNA-based vaccines, though, were a big exception as a lot of the public tracked the technology’s development as a key step toward emerging from the worst of the pandemic and then received the vaccines in droves.

mRNA technology has a lot of potential applications beyond COVID, and we talked a bit about those during the “Beyond COVID: What Does mRNA Technology Mean for Disease Treatment?” panel at last week’s Ars Frontiers event. We’ve archived the panel on YouTube; if you want to focus on the discussion about mRNA therapies, you can start at the 1-hour, 55-minute mark.

[embedded content]
mRNA is a nucleic acid molecule that instructs the cell to make specific proteins. When used as vaccines, the instructions call for a protein produced by a pathogen, such as a virus. “It helps put up a wanted poster for the immune system,” was how Nathaniel Wang, co-founder and CEO of Replicate Bioscience put it.

The production of a wanted poster is no different from other vaccines. “mRNAs is just the vessel, it’s the delivery vehicle,” said Karin Bok of the National Institutes of Health. “So let’s say you have your sandwich for lunch—mRNA is the bread that you choose to deliver that sandwich.” Where RNA differs is in how easy it is to work with. Bok said that since the mRNA is synthetic, it avoids many of the potential safety precautions that need to be taken when the vaccine is produced in cells. (Bok is the director of Pandemic Preparedness and Emergency Response at NIH’s Vaccine Research Center.) This means that we can get a vaccine into safety tests quickly and potentially test alternate vaccines in parallel.

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That ease of use affects manufacturing, as well. “You don’t need to recreate a manufacturing process for flu versus COVID-19 versus Epstein-Barr virus,” Wang said. “You just change the sequence that’s in the RNA itself, but the way you manufacture and purify that material is the same, and that’s why it’s so much faster.”

Beyond speed

Speed of development has some additional benefits. Bok named seasonal vaccines, such as the flu (and potentially COVID in the future), as a big beneficiary. Because the testing and manufacturing process go faster, we can wait a few extra months to gather additional data before committing to a specific formulation for the year's vaccine. Beyond that, Bok suggested we'll use mRNAs for additional diseases, but which ones will depend on an analysis of the specific disease and whether mRNA can provide what's needed to generate lasting immunity.

Wang, for his part, is excited by technologies that are in development (he termed them "mRNA 2.0") that could produce more protein from each RNA molecule and include signals that stimulate the immune response. This, he suggested, could lower the required vaccine dose by as much as 1,000-fold, making manufacturing even easier.

That could be good news for uses beyond vaccines. Therapies such as those for autoimmune disorders and diabetes may be based on protein injections, often done daily. But with mRNAs, we can get our cells to produce the therapies themselves. Wang said there is work toward developing mRNA-like molecules that can drive expression for weeks or even months, potentially eliminating the need for daily injections.

Further into the future, Wang said people are working on so-called "cancer vaccines," where proteins are used to restore the immune response to cancerous cells. mRNA, he suggested, was an obvious candidate for use in this work.

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All of these uses, however, depend on the public being comfortable with the continued use of mRNA, which caused a lot of suspicion in some circles after the COVID vaccine rollout. Bok partially attributed that to the speed aspect of Project

Warp Speed, though she emphasized that “we only bet money; we didn’t bet safety.” But she also acknowledged that there has been long-term mistrust of vaccines in many societies.

“I think our R&D excitement needs to come hand-in-hand with how do we instill trust in vaccines, but also in mRNA vaccines, which is a fantastic new technology that we can use for many, many infectious diseases that we don’t have vaccines for,” Bok said. She and Wang emphasized that transparency and authenticity will be key to instilling trust.

Still, the fact that we need to restore trust is a sign of just how successful this technology has been compared to where it was before COVID. “I think it’s hard to remember anything before the pandemic sometimes, but people were ready to take RNA technologies behind the shed and shoot it,” Wang said. “There were real questions on whether it could ever scale, whether it was ever going to be commercially deployable, whether there were going to be fundamental safety questions, and I think what the past few years have done is really answer all of those questions with a resounding yes, it is a scalable technology, it can be manufactured, it can be safe and deployable.”

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