

Until two years ago, mRNA vaccines had never been approved. Now, vast research offers hope in treating more than COVID-19

Faster to produce than conventional vaccines, the potential applications of synthetic mRNA to prevent illness and treat diseases seem nearly limitless

target his lab has zeroed in on – a protein called Cathepsin B – will lead to a vaccine that offers “complete protection” against schistosomiasis.

In a study released in March, Dr. Blakney and her colleagues found 427 published papers that mentioned the term “RNA vaccine” in 2021, up from 99 in 2020 and next to none in the years before. The pipelines of the three best-

The three companies have nearly three dozen more potential vaccines and medications in preclinical development. In BioNTech's case, many are personalized cancer vaccines, the focus of the company's research before it partnered with the pharmaceutical giant Pfizer to produce its COVID-19 vaccine. Moderna has candidates for influenza, RSV (a virus that can cause severe respiratory illness in the very young and very old) Zika, HIV and other viruses, along with bespoke cancer vaccines and prospective mRNA treatments for rare diseases.

Two of those medications are being tested at Toronto's Hospital for Sick Children on a handful of kids with propionic acidemia and methylmalonic acidemia, a pair of rare

The next crucial step was swaddling the modified mRNA in lipid nanoparticles, tiny globules of fat engineered primarily by University of British Columbia scientist Pieter Cullis. The lipid nanoparticles, now the subject of a messy patent fight among a handful of biotechnology companies with roots in UBC, delivered the fragile mRNA safely across

The results, though, of those zillion overnights meant that when a new virus began circulating in China in late 2019, the handful of pharmaceutical companies with

less than a year, smashing all previous records for vaccine development. And once they began to be dispensed around the world at the end of 2020 and in early 2021, their ability to prevent severe illness and death proved to be a historic breakthrough.

Some of the shine has since come off those COVID-

CoV-2 is simply not that complicated a foe. “In terms of complexity of the viral

that reduced the number of adult worms and eggs in mice by approximately 70 per cent, according to a study published in The Lancet's eBioMedicine journal.

Dr. Ndao thinks an mRNA approach could work even better against Cathepsin B. It's early days, but he's looking forward to finding out if Moderna's mRNA Access partnership lives up to its potential.

So is Dr. Cestari. His lab at McGill's Institute of Parasitology is working on finding targets for a vaccine against Chagas disease, a parasitic infection first identified in his native Brazil. Left untreated, Chagas causes irreversible heart damage.

Dr. Cestari is leading a painstaking search for the best vaccine targets by slicing the DNA

his own prototype vaccine for Chagas, but if Moderna is willing to design one for him using their mRNA and his targets, development time could drop significantly.

“In theory, when I have the code, it’s as simple as sending a text message,” Dr. Cestari said, “and someone on the other side would put it in a machine to synthesize the RNA.”

Reality is more complicated. Dr. Cestari said he and McGill would want to patent the sequences of his targets before sharing them with Moderna. He would also want to hammer out terms on shared intellectual property with an eye to ensuring a future vaccine is affordable in the Central and South American countries where Chagas is endemic.

One of the discouraging lessons of the pandemic is that, in the event of an emergency, wealthy countries will snap up life-changing vaccines and treatments for their own populations first, neglecting the welfare of the developing world. Pharmaceutical companies, meanwhile, will always have profit margins and shareholders to think of first.

When it comes to ensuring tomorrow’s mRNA breakthroughs are available to those who need them most, publicly funded universities and scientists can do their part by writing equity access provisions into legal agreements with pharmaceutical companies, said Srinivas Murthy, a UBC critical care and infectious disease professor who co-chairs the WHO’s clinical research committee on COVID-19.

“The classic line is that we socialize all the risk, namely within the universities and researchers,” Dr. Murthy said. “Then, as soon as something is there, a company runs off and just develops it and recoups all the benefits.”

In interviews with The Globe, senior officials at Moderna Canada, McGill and the University of Toronto, all said the overarching research partnership between the university and Moderna is a model for future vaccine development. The partnership is a public-private partnership that is a model for future vaccine development.