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MRNA VACCINES COULD VANQUISH COVID-19 TODAY, CANCER TOMORROW

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The night is darkest just before dawn, they say. Dark it certainly is right now. The more contagious variants of SARS-CoV-2 coming out of the U.K. and South Africa will make the pandemic worse before mass vaccination can make it better.

But take another look at some of these new vaccines. And then contemplate the dawn to come — not just its first rays in the coming months but also the bright light of future years and decades. It looks increasingly plausible that the same weapons we'll use to defeat Covid-19 can also vanquish even grimmer reapers — including cancer, which kills almost 10 million people a year.

The most promising Covid vaccines use nucleic acids called messenger RNA, or mRNA. One vaccine comes from the German firm BioNTech SE and its U.S. partner Pfizer Inc. The other is from the U.S. company Moderna Inc. (its original spelling was ModeRNA, its ticker is MRNA). Another is on the way from CureVac NV, also based in Germany.

Ordinary vaccines tend to be inactivated or weakened viruses which, when injected into the body, stimulate an immune response that can later protect against the live pathogen. But the process of making such vaccines requires various chemicals and cell cultures. This takes time and provides opportunities for contamination.

mRNA vaccines don't have these problems. They instruct the body itself to make the offending proteins — in this case, the ones that wrap around the viral RNA of SARS-CoV-2. The immune system then homes in on these antigens, practicing for the day when the same proteins show up with the coronavirus attached.

Therein lies mRNA's bigger promise: It can tell our cells to make whatever protein we want. That includes the antigens of many other diseases besides Covid-19.

In its day-to-day function, mRNA takes instructions from its molecular cousin, the DNA in our cell nuclei. Stretches of the genome are copied, which the mRNA carries into the cytoplasm, where little cellular factories called ribosomes use the information to churn out proteins.

BioNTech and Moderna shortcut this process, by skipping the whole fiddly business in the nucleus with the DNA. Instead, they first figure out what protein they want — for example, a spike on the coat around a virus. Then they look at the sequence of amino acids that makes this protein. From that they derive the precise instructions the mRNA must give.

This process can be relatively fast, which is why it took less than a year to make the vaccines, a pace previously unimaginable. It's also genetically safe — mRNA can't go back into the nucleus and accidentally insert genes into our DNA.

Researchers since the 1970s have had a hunch that you can use this technique to fight all sorts of maladies. But as usual in science, you need huge amounts of money, time and patience to sort out all the intermediary problems. After a decade of enthusiasm, mRNA became academically unfashionable in the 1990s. Progress seemed halting. The main obstacle was that injecting mRNA into animals often caused fatal inflammation.

Enter Katalin Kariko — a Hungarian scientist who immigrated to the U.S. in the 1980s and has heroically devoted her entire career to mRNA, through its ups and downs. In the 1990s, she lost her funding, was demoted, had her salary cut and suffered other setbacks. But she stuck with it. And then, after battling cancer herself, she made the crucial breakthrough.

In the 2000s, she and her research partner realized that swapping out uridine, one of mRNA's "letters," avoided causing inflammation without otherwise compromising the code. The mice stayed alive.

Her study was read by a scientist at Stanford University, Derrick Rossi, who later co-founded Moderna. It also came to the attention of Ugur Sahin and Ozlem Tureci, two oncologists who are husband and wife and co-founded BioNTech. They licensed Kariko's technology and hired her. From the start, they were most interested in curing cancer.

Today's weapons against cancer will one day seem as primitive an idea as flint axes in a surgery room. To kill a malignant tumor, you generally zap it with radiation or chemicals, damaging lots of other tissue in the process.

The better way to fight cancer, Sahin and Tureci realized, is to treat each tumor as genetically unique and to train the immune systems of individual patients against that specific enemy. A perfect job for mRNA. You find the antigen, get its fingerprint, reverse-engineer the cellular instructions to target the culprit and let the body do the rest.

Take a look at the pipelines of Moderna and BioNTech. They include drug trials for treating cancers of the breast, prostate, skin, pancreas, brain, lung and other tissues, as well as vaccines against everything from influenza to Zika and rabies. The prospects appear good.

Progress, admittedly, has been slow. Part of the explanation Sahin and Tureci give is that investors in this sector must put up oodles of capital and then wait for more than a decade, first for the trials, then for regulatory approvals. In the past, too few were in the mood.

Covid-19, fingers crossed, may turbo-charge all these processes. The pandemic has led to a grand debut of mRNA vaccines and their definitive proof of concept. Already, there are murmurs about a Nobel Prize for Kariko. Henceforth, mRNA will have no problems getting money, attention or enthusiasm — from investors, regulators and policymakers.

That doesn't mean the last stretch will be easy. But in this dark hour, it's permissible to bask in the light that's dawning.

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