Lawsuits on mRNA technology show profit-driven struggle for control over vital scientific discoveries

Part one

Benjamin Mateus, Kevin Reed
26 September 2022

Introduction

"Indeed, it was not an overnight [the mRNA vaccines], but decades of overnight and hard work which led to us—me, Drew Weissman [Colleague and close collaborator] and Pieter Cullis—to do this, and I have to say, thousands of other scientists. Science is a group activity and there is not 'I,' but 'We, we, we.' And even those people who came well before us and they are not with us anymore, we learned from them through the decades."—Senior Vice President of BioNTech in Germany, Dr. Katalin Karikó

"The number of applications for mRNA and siRNA [silencing RNA] that various companies are exploiting … we've only touched the surface of this … It's completely revolutionary. We are moving into an era of personalized therapeutics."—Dr. Pieter Cullis, Professor of Biochemistry and Molecular Biology at the University of British Columbia

On August 26, pharmaceutical and biotech company Moderna filed a patent infringement lawsuit claiming its competitor Pfizer and BioNTech illegally copied the "foundational" mRNA technology it had developed for the COVID-19 vaccines administered to billions of people internationally. According to Our World in Data, 5.3 billion people have received at least one dose and 4.9 billion at least two doses of the COVID-19 vaccine. Both companies have generated billions in revenue, making their shareholders immensely rich.

In a press statement, Moderna said it filed complaints in both the US and Germany against Pfizer and BioNTech's Comirnaty vaccine product for infringing on patents filed between 2010 and 2016 "covering Moderna's foundational mRNA technology" used in its product called Spikevax.

Moderna has made it clear that it is not seeking to have the Pfizer-BioNTech product removed from the market or an injunction against future sales of the competitive vaccine. It is also not pursuing monetary damages in "the 92 low- to middle-income countries" where vaccines have been administered.

Even though one-third of the world—2.7 billion people—have yet to receive any vaccine against COVID-19, and the virus continues to maim and kill, Moderna cynically claims that it is motivated by a "commitment to equitable global access." The $54 billion biotech firm would also like to be considered magnanimous for "also not seeking damages for activities occurring before March 8, 2022."

The corporate statement says, "Moderna expected companies such as Pfizer and BioNTech to respect its intellectual property rights and would consider a commercially reasonable license should they request one for other markets. Pfizer and BioNTech have failed to do so." The lawsuit is seeking a court judgment that will force Pfizer and BioNTech to compensate Moderna for the "ongoing use of Moderna's patented technologies."

Company CEO Stéphane Bancel said the lawsuits were being filed "to protect the innovative mRNA technology platform that we pioneered, invested billions of dollars in creating, and patented during the decade preceding the COVID-19 pandemic."

However, as Bancel went on to explain, the lawsuits are aimed at ensuring Moderna's proprietary ownership of the groundbreaking mRNA technology. The company is in pursuit of the massive profits to be derived from what it anticipates will be a series of never-ending public health applications. "As we work to combat health challenges moving forward, Moderna is using our mRNA technology platform to develop medicines that could treat and prevent infectious diseases like influenza and HIV, as well as autoimmune and cardiovascular diseases and rare forms of cancer," he declared.

A Pfizer representative said the company was "surprised by the litigation but remains confident in the intellectual property supporting their vaccine." In a statement, BioNTech said its "work is original and, we will vigorously defend against all allegations of patent infringement."

Moderna is a prototype of the capitalist enterprise as pandemic profiteer, matched in every respect, and overshadowed in size, by its gargantuan antagonist Pfizer. Moderna's NASDAQ share price went from around $20 in January 2020 to a peak of $484 in August 2021, a 24-fold increase.

Three Moderna individuals—Noubar Afeyan, chairman and co-founder; Robert Langer, a Massachusetts Institute of Technology professor and co-founder; and Timothy Springer, a Harvard Medical School professor and early investor in the company—were propelled into the Forbes list of the 400 richest individuals in America in October 2021. They were all listed with a personal net worth exceeding $3.5 billion.

The rapid rise in the fortunes of the executives and investors of Moderna is directly linked to the massive financial resources contained in the CARES Act passed by Congress and signed into law by then-President Donald Trump in the spring of 2020.

After denying the need for any response to the public health crisis in the early months of 2020, the Trump White House, under the direction of Assistant to the President, Director of Trade and Manufacturing Policy Peter Navarro, began an $18 billion handout to private corporations for the development of a vaccine called Operation Warp Speed.

Even though Moderna was already flush with cash and had designed a vaccine by February 24, 2020, the US government gave the biotech firm $483 million in mid-April. This initial cash infusion triggered a rapid rise in Moderna's stock value.

Significantly, according to details published by author J. David McSwane in his recent book *Pandemic Inc., Chasing the Capitalists and Thieves Who Got Rich While We Got Sick*, two weeks after the government grant, Moderna board member and longtime pharma executive Moncef Slaoui was awarded options by the company to purchase more than 18,000 shares at a discount that was unavailable to the public.

Meanwhile, McSwane writes, "On May 15, Trump announced that Slaoui would be one of two czars in charge of Operation Warp Speed; facing public scrutiny, Slaoui resigned from Moderna's board, forfeiting his most recent options, which had not vested. But because the Trump administration labeled Slaoui a contractor, he was able to otherwise keep his existing stake and vested options at the same time he helped direct billions that would go to that very company."

When Moderna announced positive results from its first clinical trials of the vaccine, McSwane says the firm's stock price rose precipitously, and Slaoui's stake in the company shot up to $9.1 million.

From January 1 to May 2020, McSwane says, "Moderna executives made a mint, selling off $89 million in stock. Moderna's CEO, Stéphane Bancel, pocketed $13.6 million, selling just a sliver of his 9 percent stake in the company. The company's chief financial officer, Lorence Kim, made a $37 million profit in the same time frame."

On December 18, 2020, the FDA authorized the Moderna vaccine, and the US government ordered 300 million doses for nearly $5 billion. McSwane writes, "By February 2021, roughly a year into the pandemic, Moderna executives had sold more than $321 million of stock in hundreds of transactions, for more than any other company associated with Operation Warp Speed."

While the executives and investors at Moderna were by no means alone in the unprecedented opportunity to cash out on government money with no strings attached, it is a particularly stark example of what was going on in the early months of the pandemic when hundreds of thousands of Americans and millions around the world were getting sick and dying from COVID-19. These are the financial interests that stand behind the reactionary legal drive by Moderna to establish private capitalist ownership of the scientific breakthrough of mRNA technology.

Legal disputes and generous government grants

It is not uncommon for breakthrough pharmaceutical technology patent disputes to find their way into the courts, especially when they are tied to potential financial bonanzas on new drugs. Moderna's lawsuit against Pfizer is but one of many legal disputes.

In February 2022, Arbutus and Roivant's Genevant Sciences filed a lawsuit against Moderna in the US District Court for the District of Delaware seeking damages for infringement on six patents relating to the lipid nanoparticle technology (liposomal drug delivery systems) that allows the creation of an envelope that protects the mRNA vaccine from degrading when injected into a person and allowing it to enter their cells where the SARS-CoV-2 spike is constructed allowing the immune system to develop specific antibodies to the coronavirus.

There is also an ongoing dispute between Moderna and the National Institutes of Health (NIH) over who should receive credit for inventing the central components of their COVID-19 vaccine, a byproduct of a four-year collaboration between NIH scientists and the pharmaceutical company.

Meanwhile, Moderna had received around $20 million in federal government grants several years before the pandemic to develop vaccines against various viruses, which aided their work on the COVID-19 vaccines. However, in a review of 126 patents assigned to Moderna, the company failed to disclose funding from the US federal government.

During the pandemic, $10 billion in federal government funding provided the pharmaceutical company the capital to boost its manufacturing capacity, conduct large-scale clinical trials and deliver millions of doses of the COVID-19 vaccines. Additionally, Moderna was given a lucrative multibillion dollar deal to provide the US government with hundreds of millions of doses with options on any experimental shots under development.

With COVID-19 funding having completely dried up, the latest bivalent vaccine boosters are the last of any government expenditure on these life-saving treatments. Bancel's response to these developments was telling. He said, "Either the government will find the money, or we will go to the private market. There is no way Moderna won't be there for the US booster campaign this fall." Though nearly every public health official expects fewer shots to be given, at $60 per dose, or more than three times what the government is paying, it will make up sufficiently for the difference.

Conceptually, mRNA vaccines are elegantly straightforward. By utilizing the cell's machinery as efficient molecular factories, the instructions provided in the mRNA strands are used to build replicas of the coronavirus spike protein, which are then presented to the immune system to generate the appropriate response against any future infection.

Previously, vaccines had to be manufactured as finished products and ready for administration, meaning new vaccines against similar pathogens would need to undergo the same laborious processes, which confounds vaccine development and manufacturing in general. With mRNA technology, modifications can be made almost instantly, as seen with the bivalent vaccines.

For example, the prototype of the Moderna mRNA vaccine was manufactured days after the SAR-CoV-2 virus was sequenced in early January 2020. And when the Biden administration demanded the BA.4/BA.5 version, Pfizer and Moderna had to make only simple adjustments. Within a couple of months, the products were ready for distribution to pharmacies and health care centers throughout the country.

Briefly, regarding the purpose and function of mRNA, as the figure denotes, a cell's DNA resides in its nucleus. When a signal for the construction of a protein is received, a small portion of the DNA that contains all the necessary instruction for that particular protein unravels, and a single-stranded pre-mRNA template in the form of a messenger ribonucleic acid (mRNA) is transcribed, then spliced into mRNA and transported out of the nucleus into the cell's cytoplasm where the ribosomes translate the instructions into a polypeptide chain that eventually is processed into a finished protein.

However, the technological feats that led to designing a vaccine at a moment's notice were not the sole proprietary accomplishment of Moderna. Such an astounding triumph was the product of a collective effort of ingenious experimentation and theoretical analysis by thousands of scientists spanning centuries across the globe. Their painstaking work included far more failures than successes, and it was driven by the desire to accumulate knowledge, understand the fundamental processes of nature and provide desperately needed solutions to real-life medical problems, not by the ups and downs of the Dow Jones averages.

The use of mRNA as a potential therapeutic was reportedly conceived by Robert Malone in the late 1980s while working as a postdoctoral fellow at the Salk Institute for Biological Studies in La Jolla, California, after an experiment where he used strands of mRNA mixed in fat droplets and incubated with cells obtained from fruit flies. Soon, the cells began translating the mRNA and producing protein. On January 11, 1988, he wrote in his laboratory workbook that it was potentially feasible to "treat RNA as a drug." mRNA strands are notoriously unstable and difficult to work with, making this early success a significant breakthrough and its

appreciation as a treatment revolutionary.

As Ugur Sahin and Özlem Türeci, husband and wife team at BioNTech responsible for the Pfizer mRNA vaccine, noted in a report in *Nature Reviews: drug discovery*in 2014, "The concept of nucleic acid-encoded drugs was conceived over two decades ago when Wolff et al. demonstrated that direct injection of in vitro transcribed (IVT) mRNA or plasmid DNA (pDNA) into skeletal muscle of mice led to the expression of the encoded protein in the injected muscle." Robert Malone was the second author of that paper.

Malone left Salk before obtaining his degree to join Vical, a start-up, to work with Philip Felgner, a biochemist working on positively charged liposomes, minute spherical fat droplets that could carry the negatively charged backbones of mRNA. However, patent disputes between Salk and Vical left Malone's name off the licensing deals and any claim on the profits. Malone, who has joined the right-wing media campaign to disclaim the impact of COVID-19, still bitterly contends that "they [Pfizer and Moderna] got rich on the products of my mind."

Such is the messy world of the fierce dirty business behind drug discoveries. However, no one person or corporation can make such achievements alone or place claims on them. Malone's rancorous disgruntlement is but a drop in the ocean of achievements and breakthroughs by many whose names have long been forgotten.

As an evolving discipline, science has been a byproduct of a highly developed social relation that has amassed the historical breadth of knowledge over centuries of diligent work to make the current advances in various fields possible. From such a perspective, the Moderna lawsuit must be seen as the most egregious form of exploitation of human labor. In this regard, the corporation functions to strip away any historical connection to this social reality by employing the state's legal system in the form of patent acquisition and monetizing these achievements to enrich the financial stakeholders.

There are two notable specifics to the Moderna lawsuit that need mentioning. One infringement claim in Moderna's lawsuit states Pfizer "decided to proceed with a vaccine that has the same exact mRNA chemical modification to its vaccine as Spikevax." The other claim, they state, was using a lipid nanoparticle envelope to house the template for the full-length spike protein.

Moderna asserted that this approach was developed in their work on a vaccine against the coronavirus that causes Middle East Respiratory Syndrome (MERS) a few years before the COVID-19 pandemic. Referencing these specifics, it bears reviewing the history behind these technological breakthroughs.

The history of DNA

Even before mRNA was officially recognized in 1961 and James Watson's and Francis Crick's groundbreaking discovery in 1953 of DNA's three-dimensional double helix shape, almost a hundred years of work had been made to unearth the mysteries inside cells.

Following the revolutionary work of Charles Darwin's 1859 *On the Origins of Species* and Augustinian friar Gregor Johann Mendel's work on trait inheritance in plants in the mid-1800s, a Swiss chemist by the name of Friedrich Miescher was the first scientist to isolate nucleic acid from the nuclei of white blood cells in 1869. Unlike proteins, the "nuclein" (later changed to "nucleic acid") he discovered was unlike any proteins he had seen.

The material, rich in phosphorus and resistant to degradation, was the first processed DNA. Without a clear understanding of his discovery, Miescher wrote at the time, "It seems probable to me that a whole family of such slightly varying phosphorus-containing substance will appear, as a group of nucleins, equivalent to proteins."

Over the following two decades into the end of the 19th century, interest in the nucleus and the possibility of hereditary traits within spawned extensive research into the nature of these complex molecules. In 1910, German biochemist Albrecht Kossel was awarded the Nobel Prize in medicine for isolating and describing the five organic compounds present in nucleic acids—adenine (A), cytosine (C), guanine (G), thymine (T), and uracil (U) (the last in mRNA only). Later, these compounds were understood to form the genetic "alphabet" in living cells.

Lithuanian-born biochemist Phoebus Aaron Theodore Levene, who studied medicine at the Imperial Military Medical Academy and received his degree in 1891, emigrated to New York City in 1893 where he practiced medicine. His interest in biochemistry found him devoting spare time to biochemical research and collaborating with Kossel and Emil Fischer, eventually being appointed as the head of the biochemical laboratory at the Rockefeller Institute of Medical Research in 1905.

He spent the rest of his time working on identifying the various components of DNA. He was the first to discover the order of the three components of nucleotides—phosphate-sugar-base—arrangement, the carbohydrate components of RNA and DNA, and how these molecules were put together. Many of his hypotheses about the nature of these molecules proved erroneous, but his basic discoveries proved critical for the work that followed him.

The Austro-Hungarian-born biochemist Erwin Chargaff, who emigrated to the United States during the Nazi era, carried forward the work during his tenure at Columbia University. He was profoundly influenced by a transformative paper written in 1944 by Oswald Avery and colleagues that demonstrated DNA as the container of hereditary units, or genes.

Avery wrote in 1943 about his work with pneumococci bacteria, "If we are right, and of course that is not yet proven, then it means that nucleic acids are not merely structurally important but functionally active substances in determining the biochemical activities and specific characteristics of cells and that by means of a known chemical substance it is possible to induce predictable and hereditary changes in cells. This is something that has long been the dreams of geneticists."

The simple, elegant experiment took cultured and attenuated bacteria of type II and added highly purified DNA extracted from type III. The process resulted in a new colony of type III bacteria. In short, he proved that DNA was the source of hereditary instructions for the growth of all living species and demonstrated that life's essence depends on the instructions provided by these complex molecules.

Chargaff wrote in 1971 on Avery's work, "This discovery, almost abruptly, appeared to foreshadow a chemistry of heredity and, moreover, made probable the nucleic acid character of the gene… Avery gave us the first text of a new language, or rather showed us where to look for it. I resolved to search for this text."

Over the post-war years, he established that the nucleotide composition of DNA varies between species, but regardless of the species, certain properties are maintained. The amount of A was always similar to T and G to C, or total purines were equal to total pyrimidines in the DNA. The basic alphabet and grammar of DNA were being deduced.

Meanwhile, influenced by Chargaff's discoveries and Linus Pauling's work on the structures of proteins, James Watson, Francis Crick and Rosalind Franklin attempted to elucidate the shape of DNA. Franklin, a chemist and x-ray crystallographer, in 1951, had determined that DNA can exist in two forms, and the phosphate backbone of the DNA was on the outside. Additionally, x-ray diffraction studies indicated DNA was in the form of a helix.

Conceptually, Watson and Crick took a crucial step by theorizing that DNA was made of two chains of nucleotides but in opposite directions. Then in the summer of 1952, hearing about Chargaff's findings, they

created a model with the matching base pairs interlocked in the middle of their double helix that kept the distance between the chains uniform. They recognized that each strand was a template of the other, whereby during cell division, the templates were divided and used to reproduce themselves. In 1962, Watson and Crick received the Nobel Prize in medicine. Rosalind Franklin had died in 1958 at the age of 37 from ovarian cancer.

To be continued