

# **An Examination of Moderna**

**Hayden Cole Cunningham  
Murray State University**

**Jessica Dunn  
Murray State University**

**David Durr  
Murray State University**

*Understanding the COVID-19 response for Moderna, a biotechnology company based out of the United States, and compiling the current outlooks regarding vaccinations, development of a diversified product line, and garnering a competitive edge in the biotechnology space is a costly endeavor Moderna is attempting to transverse. Declining revenues, rising costs, and low sales of Moderna's current product have deteriorated the value base. The recent increase in share price is motivated by anticipation of a potential avian flu outbreak and response. This study attempts to shed light on the current financial condition of Moderna.*

## **INTRODUCTION**

Moderna is a biotechnology company that has seen share prices rise from roughly \$30/share in early 2020 to upwards of \$430/share by mid-late 2021, the peak of COVID-19. Since the aforementioned peak of stock price, Moderna currently trades at the close of the market on March 23, 2024, at \$164/share. In the first quarter of 2024, Moderna reported a revenue of \$167 million, a -91% revenue growth compared to the first quarter of 2023(\$1.9 billion) (Nagpaul, 2024). Yet, with the strong support of international agencies to promote a yearly COVID vaccination/booster set, multiple products in late-stage phases of FDA approval that could aid in the relief of numerous serious diseases coupled with the partnership of IBM and other technology companies to combine Artificial Intelligence (AI) and Quantum Computing. It seems as if Moderna is leading the biotechnology sector on breakthrough technology that can vastly change the biotechnology industry. Through this report, along with financial breakdowns, there will be an overall conclusion on the company's future, whether investment should be made, and the terms at which that potential investment should be held.

### **Industry Profile**

The pharmaceutical industry has gained massive attention in recent years, more specifically, the 2021-2022 timeframe, due to the COVID outbreak and recent breakthroughs with diabetes/weight loss medications. The adoption of Artificial Intelligence (AI) and Quantum Computing have been large areas of focus for companies such as Merck, Moderna, and Eli Lilly. More mergers between technology providers

such as IBM and pharmaceutical companies have come to the forefront in the last 12 months as the adoption of such technology during COVID allowed for large amounts of research hours to be removed from the drug cycle as AI molecule and drug replications can be provided rapidly at a lower cost (Chadha, 2023).

In 2022, the global pharmaceutical market size was estimated at roughly \$1.5 trillion, with an expected growth of 6.2% annually.

Based on a 2023 market report by J.P. Morgan, the pharmaceutical industry faced a decline in Q4 2023 licensing deals, and an increase in de-leveraging activities from large firms due to large increases in variable credit because of expansive COVID & early-stage drug developments (McDonough & Kelly, 2024).

For the first quarter of 2024, the rise in stock price from major pharmaceutical companies such as Merck and Eli Lilly was due to large breakthroughs in GLP-1 technologies revolving around weight-loss and diabetes treatments. The focal point of this report will be on Moderna, Inc. which currently only holds one commercial product that is centered around the COVID-19 yearly treatment being pushed across international agencies.

### **Company Profile**

Moderna is a biotechnology company based in the United States. Throughout its history, it has focused on RNA and M-RNA therapeutics to treat illnesses ranging from cardiovascular, immunodeficiency, and rare cellular diseases. Moderna has alliances with companies and institutions such as Merck, Vertex, The Institute for Life Changing Medicines, The Biomedical Advanced Research and Development Authority, and more recently IBM & OpenAI (YahooFinance.com). The company is led by a Board of Directors consisting of Stephane Bancel (CEO), Noubar Afeyan (Chairman), and Francois Nader (Independent Non-Executive Director), with Bancel leading as CEO, James Mock as CFO, and Stephen Hoge as President.

The company currently employs roughly 5,600 people and in 2023 posted sales totaling \$6.85 billion – a decrease of 64.21% from 2022 (WallStreetJournal.com, 2024). The company has 5 major products in late-stage trials. These products aim at treatments for RSV, COVID-19 yearly vaccination, Norovirus, HSV, VZV/Shingles, EBV, which can lead to diseases such as Multiple Sclerosis, and lastly CMV infection, which causes birth defects. These treatments are geared to an unmet pharmaceutical need as mentioned by the company and could save insurance companies and individuals billions of dollars annually (Moderna.com, 2024).

### **History of Moderna**

Moderna is a pharmaceutical/biotechnology company based out of Cambridge, Massachusetts. Moderna was founded in 2010 and in 2011, raised \$2 billion in venture capital funding to begin research and production of RNA and mRNA therapeutics to boost immune responses in the body. In 2013, the company partnered with AstraZeneca to focus primarily on treatments for “cardiovascular, metabolic, and renal diseases, as well as cancer” which enabled Moderna to receive upwards of \$25-\$56 million in grants through the U.S. Government’s “DARPA” program in an area of “Autonomous Diagnostics to Enable Prevention and Therapeutics: Prophylactic Options to Environmental and Contagious Threats”. With the introduction to DARPA, Moderna publicly announced that their goal was to develop an mRNA vaccine capable of suppressing a global pandemic within 60 days. The partnership with DARPA is still active with recent grants in 2020-2021 for developments in a “mobile manufacturing prototype” that combines AI technology with Moderna’s existing pharmaceutical products (Businesswire.com, 2020).

Moderna, like other large pharmaceutical companies, has been active in merging with large competitors throughout its life, for example, in 2015 Moderna partnered with Merck & Co. to develop cancer treatment technologies. Out of the Merck and Moderna partnership, Keytruda has been introduced to combat various cancer forms (investors.modernatx.com, 2016). In 2018, Moderna again partnered with Vertex Pharmaceuticals to develop treatments for cystic fibrosis through gene-editing technology, the development with this technology is currently in Phase 3 out of 5 of review with the FDA, leaving Vertex and Moderna awaiting results (Wexler, 2024).

In December of 2018, Moderna became public and was responsible for the largest initial public offering of a biotechnology company in history. In 2023, Moderna acquired a Japanese genetic engineering

manufacturer – OriCiro Genetics, in Moderna’s first-ever acquisition (modernatx.com, Ridley, 2023). With this acquisition, Moderna believes it can combine its large intellectual property portfolio with OriCiro’s extensive toolbox to rapidly develop complex therapies in a highly effective manner that will benefit patients not only in the “treatment of diseases but with the speed at which solutions are brought,” (Ridley, 2023).

### **COVID-19 Response**

Due to the sector that Moderna operates in, and the vastness of impact COVID-19 had on the world economy. A section explaining the COVID-19 response and the lasting impacts on the company profile of Moderna is needed to gain more understanding of the financial operation and outlook of the company.

Due to longstanding partnerships with the U.S. government and the effectiveness of Moderna’s technology developments in mRNA therapies, Moderna was able to be at the forefront of Operation Warp Speed – a federal initiative to grant swaths of money to pharmaceutical companies to develop vaccinations and modalities of aid in response to the 2020 COVID-19 outbreak. Moderna received initial grants of \$955 million and a subsequent \$4.9 billion in funding for developing and producing upwards of 300 million doses of their COVID-19 vaccine. In 2022, Moderna received approval from the FDA for SpikeVax, a yearly COVID-19 vaccine, and a booster similar to the annual flu vaccinations. Due to the large demand for COVID-19 vaccines in recent years, Moderna has limited its current product being sold to SpikeVax. However, due to a reduction in vaccine sales revenues have subsequently plummeted due to people not receiving booster vaccination, or overall vaccination numbers dropping in recent years. This collapse in the revenue stream has caused Moderna to focus on developing a pipeline of promising biotechnology and collaborating with large technology partners to potentially usher in a more robust product line to generate revenues.

### **SWOT Analysis**

Through a SWOT analysis, the strengths, weaknesses, opportunities, and threats to Moderna can be uncovered and give investors a more sophisticated understanding of the current landscape. A thorough SWOT analysis can also expand upon Moderna's future outlook in the biotechnology sector.

#### *Strengths*

Moderna differs from other key firms in the biotechnology/vaccine innovation area due to their focus on developing key platforms within mRNA technology that can be used as a form of intellectual property, in turn allowing the firm to collect a perpetual royalty from other pharmacological-based companies.

Moderna and OpenAI – a pioneer in the growing generative AI industry – have begun collaboration on mRNA developments that dramatically reduce the time spent on base-level work with the biotechnology industry that allows Moderna’s workforce to solely focus on refining innovations that can in turn be generated into future revenues (News Details, modernatx.com, 2024). Combining the new-found capabilities of AI with the strong foothold Moderna has within its niche area of expertise, mRNA, enables the firm to work on the cutting-edge of the biotechnology industry which is vital in all technology-heavy industries as technology rapidly becomes outdated due to more firms entering the area and creating a less advantageous scenario for any firm to operate at margin.

The alliance with OpenAI is only one area of collaboration that Moderna has developed and can rely on as a strength in terms of long-term success. Moderna has collaborated and continues to collaborate with other prominent firms within the biotechnology, pharmaceutical, and healthcare space such as Merck and Vertex. As of late-2023, findings of a cancer treatment collaboration between Merck and Moderna have shown a 50% success rate in treating melanoma cases. Another collaborative venture between Merck and Moderna regarding cancer treatment found preliminary success in the treatment of non-small-cell lung cancer. Both treatment processes have entered Phase 3 of FDA trials. A Moderna spokesperson stated, “Due to success in trials of our mRNA patents, we are hopeful that by 2025 the company can begin to roll out personalized cancer treatment” (Dillinger, 2023).

Moderna has developed partnerships with U.S. governmental agencies such as DARPA and the Biomedical Advanced Research and Development Authority (BARDA) that have allowed Moderna to access grants totaling \$2.5 billion since 2013 to align in the development of vaccines for illnesses such as COVID-19 and Zika Virus (Laise, 2024). As recent as May 30, 2024, a spokesperson from Moderna concluded, “Moderna can confirm we are in discussions with the U.S. government on advancing our pandemic flu candidate, mRNA-1018,” this statement comes as avian-flu cases continue to rise internationally and highlights the proximity to business that Moderna is to the government’s concerns.

Although noted that as of Q1 2024, Moderna only has one product for sale, Moderna has roughly 40 mRNA candidates in clinical trials (Research News, modernatx.com, 2024). The extent of Moderna’s prospective pipeline covers many diseases that aim to be treated that are based on a robust mRNA platform. The main idea behind this development is that the firm can expect diversification of therapeutics coupled with the ability to take advantage of high-need niche medical fields rapidly.

### *Weaknesses*

Since the peak market cap and stock prices of Moderna witnessed in the summer of 2021, the company financials and stock price have weakened to the point that as of Q1 2024, Moderna posted a -91% drop in total revenue and comparative net loss in income compared to Q1 2023. Due to the rapid expansion and success of Moderna’s COVID-19 response, the company restricted or postponed developments of late-stage trial products due to the reliance and contracts from the U.S. government and governments abroad that essentially promised to buy hundreds of millions of doses of Moderna’s mRNA based COVID-19 vaccine and subsequently needed boosters. While in the frothing heat of the COVID-19 pandemic, Moderna witnessed a rally in market capitalization and stock price that increased their firm from a \$1-2 billion competitor in the biotechnology sector to a firm worth over \$180 billion over a one-and-a-half-year span. Yet, since the peak news cycle of COVID-19, a reduction in overall vaccination percentages has caused large-scale financial volatility for Moderna – as they made large bets in production that COVID-19 would remain top of mind for the world (Payne, 2024).

The focus applied by Moderna to a COVID-19 response and the follow-through of attempting to service the global requests of annual COVID-19 vaccinations has been met with overall reduced demands from governmental agencies, and FDA halts for new iterations of the SpikeVax vaccine which has continuously caused weakening of the financial situation of Moderna.

Moderna's financial volatility within the last 3 years creates fears that the company cannot maintain any form of an overall benchmark with the competitive landscape of the biotech industry. As of Q1 2024, Moderna posted a -91% YTY revenue growth. Over the last 2 years, Moderna has gone from operating at a roughly 65% net margin to as of Q1 2024, operating at around -116% net margin (macro trends.net, 2024). In the short-term future of 1-2 years, Moderna has focused on ramping up the speed at which it pursues patents and approvals of therapeutics that can cover a vast field of medical needs; however, the company is still only able to sell its COVID-19 vaccine, Spikevax.

Another weakness regarding Moderna’s financial health is that the company expects to spend anywhere from \$5-6 billion in research and development (R&D) over the next year (News Details, modernatx.com, 2024). The total R&D expenses for Q1 2024 totaled around \$1.1 billion for Moderna. The overall pattern for biotechnology companies to exponentially increase their R&D costs in the last 3-4 years is due to factors such as an increase in cost of capital, the rapidity of development and licensing of patents by the biotech industry which pressurizes the industry, and as explained in a 2024 interview with Moderna CFO, Jamey Mock, the increased investment in R&D has a main goal of attempting to cut down production time of products (Sweeney, 2024).

Thus, the growth of Moderna over 2020-2021 has created a firm with large expenditures and, as explained by Moderna's CFO in an interview in early 2024, “The firm before COVID was a research firm that patented products and sold its intellectual property for royalty, during COVID we made a bet that increased our size by close to 100x, and after COVID we are attempting to use our knowledge to develop low production time, highly effective therapies to financially break even in mid-2026,” (Sweeney, 2024).

With the time lag between development to trials to commercialized selling of goods, the biotechnology industry is rare to find a company that can make a 180-degree turn from only selling one product to offering a fully diversified stream of products that can be sold in mass amounts in a short amount of time. Therefore, Moderna is expected to operate in large financial deficits until at least 2026 which has caused pain in investors and a rapid decline in market investment demand.

### *Opportunities*

Without question, Moderna is the key firm regarding the 2024-2025 global endemic COVID-19 vaccine market. Based on the company expectations after the Q1 2024 earnings were posted, Moderna believes that the endemic COVID-19 vaccine market could be a \$10 billion market alone. Along with the COVID market, Moderna has vaccines in late-stage trials of the FDA approval process to target needs in RSV and avian flu treatments. Moderna expects a future total addressable market of approximately \$52 billion that they can have cornered (News Details, modernatx.com, 2024).

The manufacturing innovation that Moderna applied during the development of its COVID-19 vaccine has given Moderna the competitive edge in the ability to develop, test, and pass the trial process for FDA approval in unforeseen timespans. During COVID, Moderna had developed a main vaccine and successfully adapted highly probable vaccine boosters in a matter of a few months versus the industry standard before of 3-5 years. Moderna has facilities set to fully operate by early 2025 across England, Australia, Canada, and the US (News Detail, modernatx.com, 2024).

Along with the manufacturing process that Moderna has a competitive edge in, Moderna has been at the frontline of adapting advanced robotics, computing, and AI to advance the process of procuring potentially important protein/mRNA sequences to find cures for disease. To highlight the advancement that the high-level technology has been gained by Moderna, Dave Johnson – Chief Data and AI Officer at Moderna – explained that before the onboarding of AI and the current level of robotics, the Moderna team was able to create around 30 different mRNA sequences per month and spent countless hours to siphon out what was accurate and what was inaccurate. After the addition of automated robotics and AI, the same team can develop more than 1,000 different mRNA sequences in the same month with the added filtration of back-testing capabilities to pre-align needed effects with engineered mRNA vaccination. The ability to automate science itself allowed Moderna to create a COVID-19 vaccine ready for human trials within 42 days (Pomeroy, 2023). Moderna's key leverage uses for AI and robotics have been highlighted through longstanding partnerships with IBM and the recent partnership with OpenAI.

Due to the advantage Moderna had on the global stage with its impressive COVID response. The firm has gained strong international relationships with governments that can be positive to future business and guaranteed contracts to purchase large amounts of products. For instance, avian flu cases as of 2024 have continued to spread internationally and gain traction with the U.S. government. Moderna has been one of the first firms in talks with the U.S. government to gain funding and purchase agreements for the mRNA-1018 candidate which is being tested against numerous variants of the current avian-flu strain, H5N1. Other agencies such as the EU have expressed interest in onboarding Moderna vaccinations for the avian flu and Moderna's highly anticipated RSV vaccination pre-filled syringe product in late-stage trials (Kazis, 2024).

### *Threats*

The biotechnology industry is one of hyper-competition. As soon as a product is released, other firms with the same or more capital and the same level of engineers are aggressively producing alternatives that are cheaper and just as, if not more, effective at treating a set number of illnesses. In essence, the threat to Moderna is not just a singular firm but the industry in which the company has implanted itself. As mentioned before, before the COVID-19 pandemic Moderna had zero products it was selling and operated through royalties of patents that other biotechnology and pharmaceutical firms used.

As well, regulatory hurdles that Moderna must face such as approvals, delays, or failure of approvals, numerous regulatory bodies for a limited set of areas create a confusing message for Moderna and its investors concerning when and how it will be able to operate. For instance, SpikeVax – Moderna's yearly COVID vaccination already selling in a precursor form – has been expecting approval for international

vaccinations since the Summer of 2023 and has yet to be approved. The levels of adherence and rapidity that regulatory bodies update and change guidelines can be costly in the sense that any delay in approval of production is less product sold to the public. In late 2023, a randomized inspection by the FDA found that some items used in quality testing around a Moderna-based facility, where an experimental cancer treatment and the SpikeVax vaccine are produced, had control lapses and some items were used past expiration. No SpikeVax vaccines in the US were recalled, but it was not the first time that regulatory hurdles had harmed Moderna's vaccine production levels as in 2021 close to 2 million Moderna COVID vaccines in Japan were recalled due to having contaminants that originated from a contracted manufacturing company, Rovi. In late 2023, Moderna had contacted contracted manufacturers to reduce the outsourced amount of Moderna's COVID-19 vaccine with an initiative to restructure and produce more in-house (Wingrove, 2023).

Lastly, a major threat to any biotechnology firm, particularly Moderna, with its rapid expansion in business dealings in terms of an ever-growing mRNA database of patents is that litigation can cause extensive capital outlays, strict contractual limitations on production, and an overall reduction in international inquiry of business. In 2022, Moderna sued Pfizer and another firm, BioNTech over alleged patent infringement. As of May 2024, the European Patent Office has handed Moderna victory in this legal battle; however, there are still settlements to be placed within the U.S. (Manalac, 2024). In 2023, Moderna waded into a legal battle with the National Institute of Health (NIH) over a patent within the COVID vaccine that has since been settled out with Moderna offering co-ownership rights to the NIH and paying close to \$400 million in damages (Mole, 2023).

### **Financial Analysis**

While the awe of technology and lofty ambitions of science and the future of healthcare can often entrap investors into investing emotionally in healthcare and biotechnology companies, financial analysis of Moderna can remove the emotional aspects that cloud decision-making and call to attention aspects of current business practices that need be addressed for long-term viability.

Total revenue for Q1 2024 was \$167 million, a -91% revenue growth from Q1 2023. The cost of sales for Q1 2024 was around \$96 million. R&D expenses for Q1 2024 were \$1.1 billion. After all expenses, net income for Q1 2024 was -\$1.2 billion for Q1 2024, compared to a net income of around \$80 million for Q1 2023. The earnings per share (EPS) for Moderna as of Q1 2024 was -\$3.08. The company is broken down into Quarters instead of years in the financial analysis workbook. This is due to the volatility of growth experienced by Moderna over the last 3 years. The company has lost almost 80% of its market cap value over the last 3 years; at its peak in 2021, Moderna experienced a market cap of \$180 billion and after the Q1 2024 results Moderna holds a market cap of roughly \$40 billion. The stock price of Moderna as of May 31, 2024 was \$142.57, down from the peak in 2021 of \$449.38.

Moderna maintains a high set of liquidity ratios as they carry little current liabilities compared to their current assets, they often hold over \$10 billion in current assets in any given quarter. Yet, as of Q1 2024, Moderna has experienced a dip in current assets by nearly \$725 million due to their decline in sales and ever-increasing R&D and other operating expenses.

In terms of profit margins, Moderna over the last 2 years has experienced rapidly declining gross, operating, net margins. One could note that in Q4 2023, Moderna posted a positive net income for the quarter, yet this was due to an irregular merchandising payment to Moderna that was delayed from services provided years prior (Sweeney, 2024).

Overall, after keeping liquidity ratios high and long-term debts low, Moderna has faced extremely tough financial circumstances that have kept EPS for investors as low as -\$9.53/share through 2023. Revenue growth was decided to be tracked on a YTY basis due to the seasonality of respiratory illnesses that Moderna has solely focused on for the last 4-5 years. There has been an overall decline in revenue growth, with an overall increase in operating expenses that creates a harsh investing environment for the interim future as Moderna leaders such as the CFO and their CEO are openly discussing plans to break even financially in mid-2026.

The strategy that Moderna drafted as a form of business was to focus primarily on revenues from their COVID-19 vaccine distribution to world governments, however the dramatic decline in overall vaccinations

post-2022 cratered revenues for Moderna. R&D expenditures are expected to increase to almost \$5 billion in the year 2024. Moderna is expecting revenues of \$4 billion throughout the year with most of the income being received in the final 2 quarters (News Details, moderatx.com, 2024).

Moderna's is a company that primarily focused on research development to be sold in a royalty structure prior to COVID-19, if it is possible to acknowledge the discrepancy in the world economy during this time, the true value of the company offers a much lower expectation than what the current YTD stock price offers. Moderna has yet to finalize production of its sole product, SpikeVax, for 2024 and maintains a strong pipeline of prospective technology that can be halted and delayed through regulatory bodies. In finality, the company is more or less betting on a product that has not been rolled out, making this company one to avoid investment until a stronger pattern of financial returns can be generated. Outside of currently keeping liquidity high, the company fails to meet baseline expectations of an investment grade company. In focusing on liquidity, the company's leaders have mentioned throughout cited interviews that the large swath of liquid assets it is holding will be depleted due to rising R&D costs for roughly the next year to push products to be sold.

## CONCLUSION

Based on the SWOT analysis, company profile, and financial analysis, it has become clear that if the goal of the interested firm is to invest in a group of profit-generating companies with diverse products and global outreach, then Moderna should be classified as non-investment. The company is in a major rebirth and does not see itself as profitable or competitive in generating profits until at least 2026. While the speculative nature of investing could attempt to sway this attempt, let it be understood that speculative avian flu claims and talks of deals between the U.S. government and Moderna have primarily driven the 2024 YTD increase of 30% in stock price for Moderna. While important, that reason of speculation does not change the fact the company is losing an average of \$1.178 billion per quarter from 2023 to 2024. Moderna only has one viable vaccine for sale and has seen a reduction in royalty payments to the tune of almost 50% due to the competitive nature of the large-cap biotechnology firms. Thus makes Moderna a less viable investment option than a competitor such as Merck or Vertex which has a plethora of therapies that span many health needs and can create a sustainable, less volatile return than that of Moderna. Moderna is still in the early stages of developing independent products, as in 2018 they were primarily a research firm. After 4-5 years, the company's performance could give a more robust knowledge of Moderna's long-term future that could be a proper launch pad into a biotechnology firm that is a mainstay within the global economy.

## REFERENCES

- Berniatio, S. (2022, September 16). Moderna v. Pfizer: What the patent infringement suit means for biotech. *Harvard Business Review*. Retrieved from <https://hbr.org/2022/09/moderna-v-pfizer-what-the-patent-infringement-suit-means-for-biotech#:~:text=Covid%20vaccine%20producer%20Moderna%20has%20sued%20fellow%20vac,cine,may%20start%20enforcing%20its%20patents%20in%20higher-income%20countries>.
- Business Wire. (2020, October 8). *DARPA awards moderna up to \$56 million to enable small-scale, rapid mobile manufacturing of Nucleic Acid Vaccines and therapeutics*.
- Chadha, J. (2023, April 3). *Key pharma trends in 2023*. Pharma Manufacturing. Retrieved from <https://www.pharmamanufacturing.com/home/article/33002742/key-pharma-trends-in-2023>
- Dillinger, K. (2023, December 14). *Experimental cancer vaccine, combined with immunotherapy, continues to show benefits against melanoma, trial shows*. CNN.
- J.P. Morgan. (2023a, December). *2023 annual Biopharma Licensing and Venture Report*. Retrieved from <https://www.jpmorgan.com/content/dam/jpmorgan/documents/cb/insights/outlook/jpmorgan-dec-2023-biopharma-licensing-and-venture-report.pdf>

- Kazis, J. (2024, May). *Moderna and Pfizer in Talks With U.S. To Make a Bird Flu Vaccine*. MSN. Retrieved from <https://www.msn.com/en-us/health/other/moderna-and-pfizer-in-talks-with-u-s-to-make-a-bird-flu-vaccine/ar-BB1mSaK2>
- Kenilworth, N.J., & Cambridge Mass. (2016). *Merck and Moderna announce strategic collaboration to advance novel mrna-based personalized cancer vaccines with Keytruda® (pembrolizumab) for the treatment of multiple types of cancer*. Retrieved from <https://investors.modernatx.com:443/news/news-details/2016/Merck-and-Moderna-Announce-Strategic-Collaboration-to-Advance-Novel-mRNA-Based-Personalized-Cancer-Vaccines-with-KEYTRUDA-pembrolizumab-for-the-Treatment-of-Multiple-Types-of-Cancer/default.aspx>
- Laise, E. (2024, May). *Moderna's stock climbs on report that Bird-flu vaccine*. Retrieved from <https://www.marketwatch.com/amp/story/modernas-stock-climbs-on-report-that-bird-flu-vaccine-funding-is-near-cf4f8d65>
- Macrotrends. (n.d.). *Moderna Gross margin 2017-2024: Mrna*. Retrieved from <https://www.macrotrends.net/stocks/charts/MRNA/moderna/gross-margin>
- Manalac, T. (2024, May 20). *Moderna gets win in covid-19 patent dispute with Pfizer, BioNTech*. BioSpace. Retrieved from <https://www.biospace.com/article/moderna-gets-win-in-covid-19-patent-dispute-with-pfizer-biontech/>
- Mikulic, M. (n.d.). *Topic: Global Pharmaceutical Industry*. Statista. Retrieved from <https://www.statista.com/topics/1764/global-pharmaceutical-industry/#editorsPicks>
- Moderna, Corp. (2024, March). *Moderna advances multiple vaccine programs to late-stage clinical trials*. Retrieved from <https://investors.modernatx.com/news/news-details/2024/Moderna-Advances-Multiple-Vaccine-Programs-to-Late-Stage-Clinical-Trials/default.aspx>
- Moderna, Inc. (2024b). *(mRNA) latest stock news & headlines - yahoo finance*. Retrieved from <https://finance.yahoo.com/quote/MRNA/news/>
- Moderna. (2023b). *Moderna to acquire Oriciro Genomics*. Retrieved from <https://investors.modernatx.com/news/news-details/2023/Moderna-to-Acquire-OriCiro-Genomics/default.aspx>
- Moderna. (2024a, March). *Moderna and OpenAI Collaborate to advance mRNA medicine*. Retrieved from <https://investors.modernatx.com/news/news-details/2024/Moderna-and-OpenAI-Collaborate-To-Advance-mRNA-Medicine/default.aspx>
- Mole, B. (2023, February 24). *As Covid Vaccine Patent Dispute Drags on, Moderna Forks over \$400m to NIH*. Ars Technica. Retrieved from <https://arstechnica.com/science/2023/02/moderna-forks-over-400m-to-nih-amid-dispute-over-covid-vaccine-ip/>
- MRNA | moderna inc.. company profile & executives - WSJ. (2024c).
- Pomeroy, R. (2023, November 1). *How ai played an instrumental role in making mrna vaccines*. Big Think. Retrieved from <https://bigthink.com/health/ai-mrna-vaccines-moderna/#:~:text=Johnson%20and%20his%20team%20put%20AI%20and%20automated,body%20%E2%80%94%20more%20bang%20for%20the%20biological%20buck.>
- Sweeney, J. (2024, January 10). *At Moderna, a CFO vows to de-risk R&D as mrna tech promises to shorten success path*. Forbes. Retrieved from <https://www.forbes.com/sites/jacksweeney/2024/01/10/at-moderna-a-cfo-vows-to-de-risk-rd-as-mrna-tech-promises-to-shorten-success-path/?sh=31cae0df7b3f>
- Vertex Pharmaceuticals. (2020, September 16). *Moderna and vertex establish new collaboration to treat cystic fibrosis using gene editing*. Retrieved from <https://investors.vrtx.com/news-releases/news-release-details/moderna-and-vertex-establish-new-collaboration-treat-cystic>
- Wexler, M. (2024, January 10). *Phase 3 trials of new triple-combo CFTR modulator to report results*. Cystic Fibrosis News Today. Retrieved from <https://cysticfibrosisnewstoday.com/news/phase-3-trials-new-triple-combo-cftr-modulator-report-results/>
- Wingrove, P. (2023, December). *Exclusive: US FDA finds control lapses at Moderna Manufacturing Plant*. Reuters. Retrieved from <https://www.reuters.com/business/healthcare-pharmaceuticals/us-fda-finds-control-lapses-moderna-manufacturing-plant-2023-12-15/>



- Yahoo! (2024a, April). *Moderna's sales from its only product, the COVID-19 vaccine, fell 91% from last year*. Yahoo! Finance. Retrieved from [https://finance.yahoo.com/news/moderna-sales-only-product-covid-212106400.html?fr=sycsrp\\_catchall](https://finance.yahoo.com/news/moderna-sales-only-product-covid-212106400.html?fr=sycsrp_catchall)
- Yahoo! (2024b, May). *Decoding Moderna Inc (mRNA): A strategic swot insight*. Yahoo! Finance. Retrieved from [https://finance.yahoo.com/news/decoding-moderna-inc-mrna-strategic-050140891.html?fr=sycsrp\\_catchall](https://finance.yahoo.com/news/decoding-moderna-inc-mrna-strategic-050140891.html?fr=sycsrp_catchall)
- Yahoo! (2024c, May). *Moderna reports first quarter 2024 financial results and provides business updates*. Yahoo! Finance. Retrieved from [https://finance.yahoo.com/news/moderna-reports-first-quarter-2024-103000644.html?fr=sycsrp\\_catchall](https://finance.yahoo.com/news/moderna-reports-first-quarter-2024-103000644.html?fr=sycsrp_catchall)