Moderna Stock (MRNA), USA in comparison to BioNTech SE (BNTX), Germany

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A friend of mine at a private Washington University, School of Medicine in Saint Louis, MO, USA, had been dreaming for quite some time to sail around the world. By saving a lot his wages, recently, he bought before COVID-19, for several thousand dollars a used sailing boat, with the hope that when he will decide to retire, he will sell the house and sail the dream.

Moderna (MRNA)

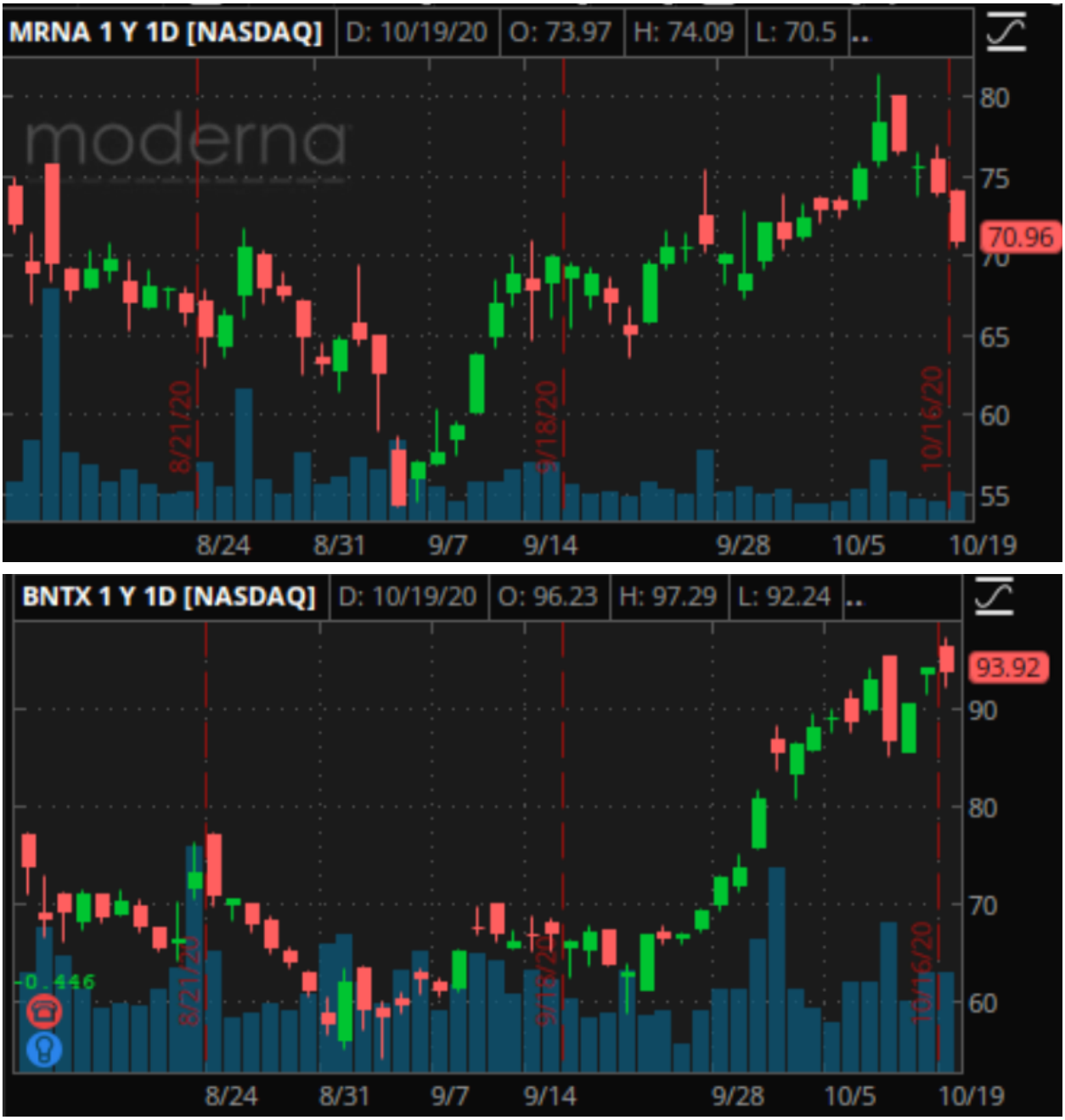
This reminded me recently the Chief Executive Officer of ***Moderna Therapeutics***, Stéphane Bancel, who from 07/24/2020 to 10/16/2020 (up to five days earlier) sold over 465 thousands ***MRNA*** stock shares for a total of more than $32M, with a weighted average price of the ***MRNA*** share of $70.00. For the $32M, Mr. Bancel can buy an Italian customizable dream superyacht as shown in the Figure 1, which is much safer than my friend's used sailing boat for going around the world. The question is why Mr. Bancel sells at this price (at $70 per share) when the ***MRNA*** stock is expected to go higher with the hope of producing world class COVID-19 mRNA/S-protein-based vaccine? Similar, but with smaller values during the same time, Stephen Hoge, President of ***Moderna*** and Tal Zvi Zaks, Chief Medical Officer of the same company have made respectively 14.2M and 23.76M. Is ***Moderna*** leadership concerned with some internal information of ***Moderna*** that we mere mortals' outside investors do not know? Based on the following analysis they look normal insider selling.

Figure 1. A dream superyacht Biglieto T-Line for $32M customizable.

Let us turn first to the dim reality. There are 221K people dead in the US and 8.32M infected result of virus COVID-19, while 1.13M dead and 40.8M infected worldwide. Not only we have lost our loved ones, but our lives are not the same as before following lockdowns of cities and reopening under COVID-19 pandemic mixed with testing, tracing, and treatment by self-isolating at home or rushing at the emergency in a hospital. We know that ***Moderna*** (founded in 2010, is in Cambridge, Massachusetts with 830 employees) does not have any products yet approved, although its stock target price is expected to be $92.54 as of today. There is a clinical trial in progress (1), a phase 3, randomized, stratified, observer-blind, placebo-controlled study to evaluate the efficacy, safety, and immunogenicity of mRNA-1273 SARS-CoV-2 vaccine in adults aged 18 years and older, a ***Moderna***'s vaccine candidate. ***Moderna*** has done the research and development of mRNA-1273 (producing LNP (lipid nano particle)-encapsulated mRNA vaccine for encoding S (spike) protein) (2, 3), while the clinical trial is a collaboration of ***Moderna***, the US National Institutes of Health (NIH) and researchers in the COVE study, including collaboration with NIAID and BARDA. At the ***Moderna***'s site (4) it says that in the COVE Phase 3 Study as of Thursday, October 22, 2020 30,000 participants are enrolled with

37% from minorities, of which most participants have received their second vaccination. The trial has started on July 27, 2020 and it is expected to be completed in its entirety by October 2022. Based on the FDA documents, a COVID-19 vaccine that demonstrates to be safe and effective, as well as manufactured in a consistent manner will be licenses by the FDA (5).

Figure 2. A partial year-day candlestick moving price of ***Moderna*** stock (***MRNA***) and of ***BioNTech*** ADR stock (***BNTX***) (source: ThinkOrSwim software build 1965, of TDAmeritrade, as of 10/20/2020)



Moderna has signed an agreement with the U.S. government to supply 100 million doses of its coronavirus vaccine with an option to add another 400 million doses. It has a deal with the Canadian government to supply 20 million doses with an option to add 36 million additional doses. (6) ***Moderna*** has a contractual framework in place for the initial purchase of 80 million doses of mRNA-1273 on behalf of all European Union Member States, plus an option to purchase up to a further 80 million doses, to be supplied once a vaccine has proven to be safe and effective against COVID-19. (7) Also 40 million doses in discussion with Takeda possibly for Japan. (8)

Money awarded: On August 11, 2020, the US government agreed for an award of up to $1.525B for the manufacturing and delivering of 100 million doses of mRNA-1273 including incentive payments for timely delivery of the product. Previous award of up to $955M from Biomedical Advanced Research and Development Authority (BARDA) for the development of mRNA-1273 to licensure, the two awards together brings the U.S. government commitments for early access to mRNA-1273 to up to $2.48B.

Production and Distribution: As I mentioned in the start, ***Moderna*** does not have the experience of such large-scale production. But, as it is normal in the pharma business they have contracted production and distribution of its mRNA-1273 vaccine. They are relaying on manufacturing capabilities of strong partners and their strength in geographical distributions. One of them is Lonza (with locations in the US and Europe). In the agreement they say: ***Lonza*** Ltd. (***SIX: LONN***) announced a 10-year strategic collaboration agreement to enable larger scale manufacture of ***Moderna***'s mRNA vaccine (mRNA-1273) against the novel coronavirus (SARS-CoV-2) and additional ***Moderna*** products in the future worldwide. (10) A portion of the funding for the establishment of manufacturing operations at ***Lonza*** U.S. is covered by ***Moderna***'s contract with BARDA. Another production partner is ***Catalent*** Inc (***NYSE: CTLT***). Under the agreement (11) it says that ***Catalent*** will provide vial filling and packaging capacity, as well as additional staffing required for 24×7 manufacturing operations at the site to support production of an initial 100 million doses of the vaccine candidate intended to supply the U.S. market starting in the third quarter of 2020. The companies are in discussions to secure fill-finish capacity for continued production of hundreds of millions of additional doses. Sites are Bloomington, Indiana, as well as in Brussels, Belgium and Anagni, Italy. A third partner is ***Rovi***, Spain's Laboratorios Farmacéuticos Rovi SA to scale up the production of its potential COVID-19 vaccine to supply markets outside the United States. (12) ***Moderna***'s pipeline forecasts should improve substantially if the mRNA-1273 is found to be both safe and effective. At a cost price of about $16.5 per dose, if the U.S. government exercises the option to purchase up to 400 million additional doses in four 100 million-dose tranches, **Moderna** will receive up to an additional $6.6B, which I would assume will be shared in some way with vaccine production and distribution partners also.

Moderna currently has the following candidates targeting viruses and types of cancer:

A. Vaccines against respiratory infections: 1. COVID-19 vaccine (mRNA-1273); 2. Influenza H7N9 (mRNA-1851); 3. Respiratory syncytial virus (RSV) vaccine for older adults (mRNA-1777 and mRNA-1172 or V172 with Merck); 4. RSV vaccine for young children (mRNA-1345); 5. Human metapneumovirus (hMPV) and parainfluenza virus type 3 (PIV3) vaccine (mRNA-1653); **B. Vaccines against infections transmitted from mother to baby**: 6. Cytomegalovirus

(CMV) vaccine (mRNA-1647); 7. Zika vaccine (mRNA-1893 with BARDA); **C. Vaccines against highly prevalent viral infections**: 8. Epstein-Barr virus (EBV) vaccine (mRNA-1189).

To date, ***Moderna*** has demonstrated positive Phase 1 data readouts for prophylactic vaccines (H10N8, H7N9, RSV, chikungunya virus, hMPV/PIV3, CMV, and Zika). ***Moderna***'s CMV vaccine is currently in a Phase 2 dose-confirmation study. ***Moderna***'s investigational Zika vaccine (mRNA-1893), from a Phase 1 study, was granted FDA Fast Track designation, while as mentioned above the COVID-19 vaccine is in the phase 3 clinical trial. In a presentation in September 2020, Mr. Bancel said that they are increasing investments in developing a seasonal flu vaccine given the unmet need for highly effective vaccines. In collaboration with ***Vertex (Nasdaq:VRTX***), they are entering also in the field of gene editing using ***Moderna***'s technology, where ***Moderna*** will receive a start of $75M upfront, with potential for additional development, regulatory and commercial milestones and royalty payments.

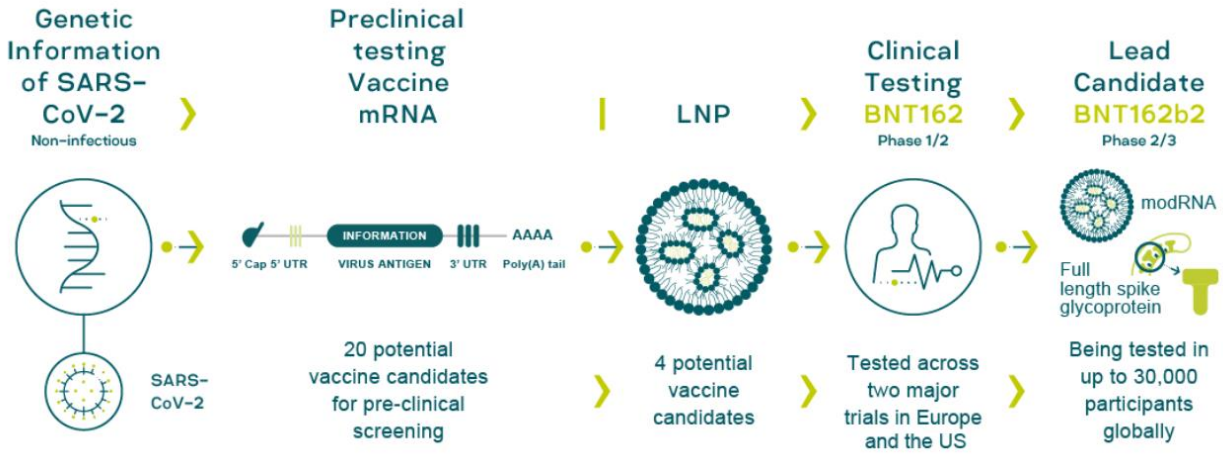
Moderna's CEO: Stéphane Bancel, since October 2011; five years as CEO at the French diagnostics company bioMérieux SA; six years served in various roles at Eli Lilly. He holds a Master of Engineering degree from École Centrale Paris, a Master of Science in chemical engineering from the University of Minnesota, and an M.B.A. from Harvard Business School.

Patents: ***Moderna*** has been granted more than 240 patents in the United States, Europe, Japan and other jurisdictions, protecting fundamental inventions in the mRNA therapeutics space, with several hundred additional pending patent applications covering key advances in the field. (14) It is not clear what part of the patents, or individual patents of ***Moderna*** (15) are owned by the US NIH research members on COVID-19 vaccine collaboration, so they can claim royalty payments.

What about its competitor BioNTech SE (Nasdaq:BNTX)?

The ***BioNTech SE*** company is founded in 2008 and is located in Mainz, Germany. It has sponsored an advanced clinical trial, a phase 1/2/3, placebo-controlled, randomized, observe-blind, dose-finding study to evaluate the safety, tolerability, immunogenicity and efficacy of SARS-COV-2 RNA vaccine candidates against COVID-19 in healthy individuals. (16) The vaccine is similar with the one of Moderna, although they have developed their own research product. The following is in layman's terms how BioNTech explains their vaccine, containing mRNA / messenger RNA of COVID-19, that provides instructions for a human cell to make a harmless version of a target protein, which activates the body's immune response against the SARS-CoV-2 virus. They expect this vaccination approach will stimulate the immune system to generate protective antibodies. (Ref. 17 and Figure 3) In fact, they have tested the vaccine already in phase I with human volunteers in Germany and US and the results supported the selection of BNT162b2 for advancement to a phase 2–3 for safety and efficacy evaluation. (18) From the preliminary results. the immune systems learn how to recognize the SARS-CoV-2 virus spike glycoprotein and thus, the virus itself upon exposure and prevent infection. For both companies ***Moderna*** and ***BioNTech***, these mRNA vaccines do not contain the virus itself and therefore pose no risk of infection. **Figure 3** shows that ***BioNTech SE*** has used similar LNP technique as ***Moderna***. Furthermore, ***BioNTech*** based on the research performed has a diverse portfolio and product candidates for handling cancer, infectious diseases, and rare diseases (see the unmarked page 6 of Ref 19 in German and Ref 20 in English).

Figure 3. The ***BioNTech*** procedure chain from production to final testing of their most recent vaccine product BNT162b2 followed in phase III clinical trials (source: borrowed as is from reference 17).



Production and Distribution: Different from ***Moderna***, the production and distribution are based on the collaboration with ***Pfizer*** (***Nasdaq:PFE***). Although a word agreement was that ***BioNTech*** and ***Pfizer*** were going to develop together COVID-19 vaccine (50:50 in expense and revenue), because ***Pfizer*** is investing much more money, the written document details that ***Pfizer*** in the collaboration with ***BioNTech*** is contributing its vaccine clinical research and development, regulatory, manufacturing and distribution infrastructure and capabilities. Therefore, the ***BioNTech*** will receive an upfront payment of $185 million, including an equity investment of approximately $113M, and be eligible to receive future milestone payments of up to $563M for a potential total consideration of $748M. (21) ***Pfizer*** has already spent a lot of dollars in preparation for the global distribution of the vaccine. (22)

Money awarded: In addition to the agreement with ***Pfizer***, ***BioNTech*** has recently received $444.3M in a grant from the German Government, to support the accelerated development of its BNT162 vaccine. Although the US government has offered ***Pfizer*** money for this vaccine, ***Pfizer*** has pledged not to take government funding and will continue to cover its own expenses in developing the vaccine. (23) The U.S. government will pay $1.95B to buy COVID-19 vaccine being developed by Pfizer Inc and German biotech BioNTech SE to inoculate 50 million people if it proves to be safe and effective. (The price tag of $39 for a two-dose course of treatment). (24)

Other partnerships: The ***BioNTech*** has a partnership for its vaccine with the Chinese firm, ***Fosun Pharma***. Fosun Pharma will pay ***BioNTech*** up to $135M in upfront and potential future investment and milestone payments; the two companies will share future gross profits from the sale of the vaccine in China. (25)

Pfizer CEO Albert Bourla has said that approximately 30,000-participants have enrolled for the vaccine BNT162b2 already. An additional sample of 10,000 young age participants is in recruitment. There is a good chance the company will know the success of vaccine by the end of

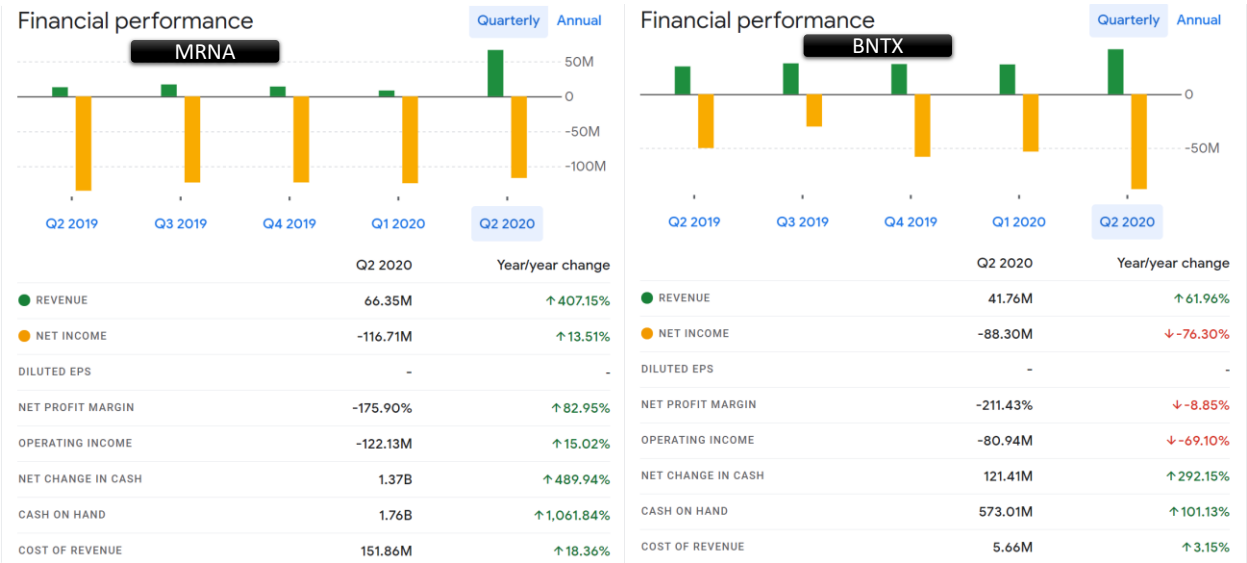
October or the end of November depending on the FDA rules of approval. Pfizer hopes to make two improvements in the next generation of COVID-19 vaccine, eliminating the need to keep the vaccine frozen (at -80 degree) and altering the technology so only one dose will be needed, instead of two. (26)

The ***BioNTech*** stock is traded in the US NASDAQ market with the label ***BNTX*** with a suffix ADR (which notes an American Depositary Receipt, a certificate issued by a U.S. depository bank representing a share of a foreign company's stock. The ADR trades on U.S. stock markets as any domestic shares would).

BioNTech SE's CEO: Uğur Şahin**,** has studied at the University of Cologne (1984–1990), at the University of Cologne (1993), and at the Saarland University (1999). Together, with his wife the BioNTech Chief Medical Officer Özlem Türeci they sold their first company, Ganymed Pharmaceuticals, for $1.66 billion before focusing on ***BioNTech***.

Financials: Moderna and BioNTech SE: They are both at the top of their value chain, but they both have contracted the production and distribution of their COVID-19 vaccines to other strong pharmaceutical partner companies. As it is expected, both ***Moderna*** and ***BioNTech*** have negative net income in their financial statements for the second quarter of 2020, because they are performing new research and development. They have both cash on hand with larger amount of ***Moderna*** ($1.76B) compared to ***BioNTech*** (573.01M). (Figure 4) and with a difficulty in the financial accounting for how to account for them. (27) Shares outstanding are respectively 380.53M and 232.36M. As of today, BioNTech has not sold insider owned stocks. Today Moderna's MRNA target price is $92.54, but has not reached today that price, while BioNTech BNTX target price is $80.62 and has passed this one. (Source finviz.com)

Figure 4. Partial Financial Statement summary for companies Moderna and BioNTech (source: Google Finance as of 10/23/2020).



	Q2 2020	Year/year change
REVENUE	66.35M	↑407.15%
NET INCOME	-116.71M	↑13.51%
DILUTED EPS	-	-
NET PROFIT MARGIN	-175.90%	↑82.95%
OPERATING INCOME	-122.13M	↑15.02%
NET CHANGE IN CASH	1.37B	↑489.94%
CASH ON HAND	1.76B	↑1,061.84%
COST OF REVENUE	151.86M	↑18.36%

	Q2 2020	Year/year change
REVENUE	41.76M	↑61.96%
NET INCOME	-88.30M	↓-76.30%
DILUTED EPS	-	-
NET PROFIT MARGIN	-211.43%	↓-8.85%
OPERATING INCOME	-80.94M	↓-69.10%
NET CHANGE IN CASH	121.41M	↑292.15%
CASH ON HAND	573.01M	↑101.13%
COST OF REVENUE	5.66M	↑3.15%

Moderna and ***Pfizer*** together with ***BioNTech SE*** are the closest companies for COVID-19 vaccine approvals. Their futures are bright based on the worldwide existing demands for the COVID-19 vaccines. Let us hope their final test results will be positive and have the appropriate efficacy in contributing for protecting humankind from COVID-19.

Updates: 10/27/2020

1. Qatar has signed an agreement with the drug maker Moderna Inc to buy its potential COVID-19 vaccine as soon as it is approved and released for global use. Earlier Qatar had signed an agreement with Pfizer and BioNTech to supply Qatar with their vaccines too.
2. Moderna Inc said on Tuesday United Kingdom's health regulator has started a real-time review of its experimental COVID-19 vaccine candidate. The company has begun a rolling data submission from its vaccine candidate to UK's Medicines and Healthcare products Regulatory Agency (MHRD) for it to start its independent assessment of evidence as and when it becomes available. Such a process allows for a reduced time to approve a treatment, while maintaining the same standards of safety and effectiveness. Moderna said earlier this month it was going to apply for real-time reviews of its experimental COVID-19 vaccine to Europe, following rolling reviews of shots of its rivals Pfizer Inc and AstraZeneca. Canada's health ministry is also in the process of reviewing Moderna's COVID-19 vaccine candidate in real time, the company said earlier this month. (https://reut.rs/3kztkvr)

Updates: 10/29/2020

1. Today it was confirmed what we had reported before in the main pages of this report, that the Ministry of Health, Labour and Welfare of Japan and Takeda Pharmaceutical Co., Ltd (NYSE: TAK) have agreed to purchase and distribute 50 million doses of mRNA-1273, Moderna's vaccine candidate against COVID-19, to support Japan's aim of providing vaccines to the Japanese public as soon as possible, subject to necessary regulatory approvals. Moderna is responsible for the manufacture and supply of Moderna's vaccine candidate, and Takeda, with the support of the MHLW is responsible for all import, local regulatory, development and distribution activities in Japan to ensure timely access starting during the first half of 2021.
2. Based on a summary of the vaccines at work for COVID-19 the ones from Pfizer/BioNtech/Fosun and Moderna are the closest for approval if the results from phase 3 clinical trials are successful. (see Figure 5 for several vaccines in progress and a few of them inactivated) (28).
3. Pfizer executives had expected data from their 44,000-person international study would show by Oct. 31 how well it prevents coronavirus infections. But on a conference call discussing the company's third-quarter results, CEO Albert Bourla said the answer may not come until next week. Bourla said the independent committee monitoring its final-stage human study still hasn't done the first interim analysis of data because the study hasn't reached **the predetermined point for that analysis — when 32 of the study volunteers, who've received either Pfizer's vaccine or a dummy shot, become**

infected. He added that the monitoring committee has not yet unblinded the data to reveal which of the infected participants got the vaccine versus the placebo. Pfizer said the final-stage trial has now enrolled nearly all of the planned participants. Nearly 36,000 had received their second shot as of Monday. The company could seek approval for emergency use from U.S. regulators in late November. Pfizer **estimates it will have safety data from a two-month follow up on the first 22,000 patients in the third week of November** and **will have manufacturing quality data before that**. Pfizer can apply shortly after that for emergency use authorization from the U.S. Food and Drug Administration. In an interview, Bourla said he doesn't know whether Pfizer will be the first company to get that authorization. **If it gets emergency use approval this year, Pfizer might have enough vaccine for about 15 million people. It's made hundreds of thousands of doses so far, banking on the vaccine being approved**. (29)

4. Moderna CEO Stéphane Bancel said it will be **November 25 at the earliest before the company can seek an emergency EUA**. The biotech will compile two-month safety data for at least half of trial participants who have received their second doses. In the phase 3 trial, the 15,000th participant received the second dose on Sept. 25. (30) Moderna outsourced the handling of data collection to the contract research firm PPD Inc. (31) Moderna is running neck and neck with Pfizer/BioNTech on COVID-10 vaccine approval.

Updates: 10/30/2020

1. ***Moderna reports 3Q company results***: Bancel/ Zak/ Meline: As a snapshot of Moderna has over 1,200 employees, in October 2020, the broad pipeline continues to progress well: Fully enrolled Phase 3 program with MRNA-1273; four Phase 2 trials with CMV, MRNA-1647, Phase 3 trial is expected to begin in 2021 personalized cancer vaccine, VEGF with AstraZeneca and now OX40 ligand, seven ongoing Phase 1 programs and 12 positive Phase 1 studies. The Moderna vaccine franchise has six programs in development addressing the major unmet needs; Five immuno-oncology programs in the clinic, four programs in rare disease and two programs in autoimmune disease; with 32,000 participants and patients in the trials. Moderna has an international manufacturing capacity and capabilities with partners, Lonza, ROVI and Catalent; strategic partnerships with companies Merck, AstraZeneca and Vertex. Moderna has a strong balance sheet, ended Q3 2020 with cash and investments of $3.97 billion compared to $3.07 billion at the end of Q2.
2. ***Moderna's MRNA-1273***: out of 30,000 phase 3 participants, 37%, 6,000 are Hispanic or Latino participants and 3,000 Black or African-American participants. The statistical analyses will be done at two interim analyses at 53 and 106 COVID-19 events and a final analysis triggered at 151 events; At the first interim analysis, in order to call it a success, Moderna will need to show vaccine efficacy of 74% or greater; storage conditions of minus 20 degrees Celsius for six months, refrigeration temperatures of two to eight for up to a week and room temperatures conditions for up to 12 hours after thaw. No special handling or dilution is required part of vaccination with MRNA-1273. Agreements: the agreement with the US government for 100 million doses and options for an additional

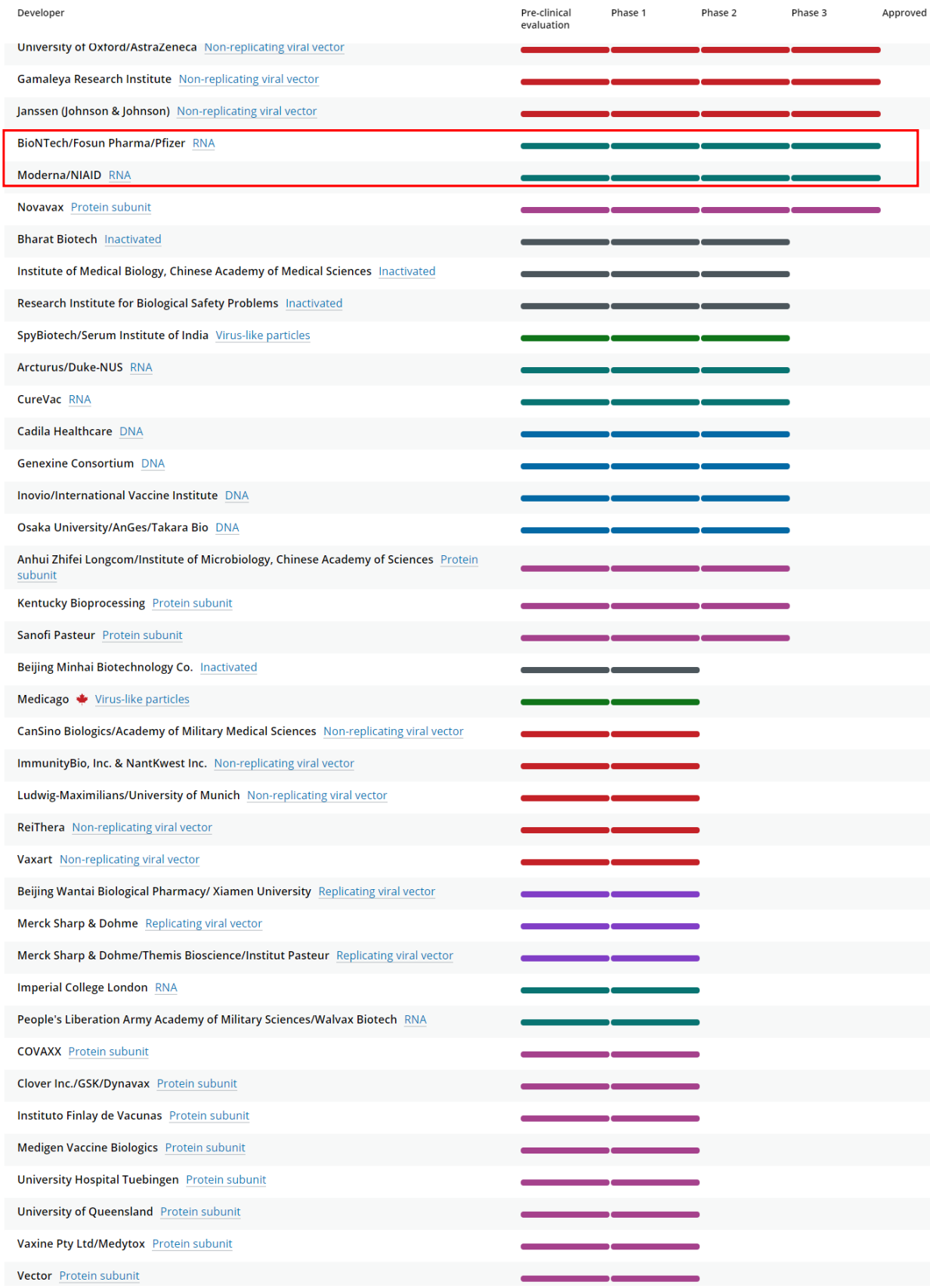
400 million doses.; a deal with Japan for 50 million doses. Canada has confirmed 20 million doses with an option for an additional 36 million. Moderna has signed agreements with Switzerland, Israel and Qatar, and there are several other countries that have signed agreements that have not been publicly disclosed. Pricing for agreements with smaller volume were executed at $32 per dose or $64 for two vaccination course to $37 per dose or $74 per course. Moderna retains worldwide rights to develop and commercialize MRNA-1273. Without a corporate partner, Moderna will realize all the profits from their COVID-19 vaccine."

3. **Moderna's Third Quarter 2020 Financial Results**: ***Cash Position***: Cash, cash equivalents and investments as of September 30, 2020 and December 31, 2019 were $3.97 billion and $1.26 billion, respectively. ***Net Cash Provided by Operating Activities***: Net cash provided by operating activities was $762.7 million for the nine months ended September 30, 2020 compared to $(359.9 million) used in operating activities for the same period in 2019. Net cash provided by operating activities increased significantly in 2020 mainly due to an increase in deferred revenue attributable to deposits of $1.17 billion received based on the supply agreements with the U.S. Government and several international government agencies for future mRNA-1273 vaccine supply. ***Cash Used for Purchases of Property and Equipment***: Cash used for purchases of property and equipment was $44.1 million for the nine months ended September 30, 2020 compared to $24.9 million for the same period in 2019. ***Revenue***: Total revenue was $157.9 million for the three months ended September 30, 2020 compared to $17.0 million for the same period in 2019. Total revenue was $232.7 million for the nine months ended September 30, 2020 compared to $46.2 million for the same period in 2019. Total revenue increased for both the three month and nine month periods in 2020, due to increases in grant revenue, primarily due to BARDA agreement related to mRNA-1273 vaccine candidate development. ***Research and Development Expenses***: Research and development expenses were $344.5 million for the three months ended September 30, 2020 compared to $119.6 million for the same period in 2019. Research and development expenses were $611.5 million for the nine months ended September 30, 2020 compared to $378.4 million for the same period in 2019. The increases for both the three month and nine month periods in 2020 were mainly due to increases in clinical trial expenses, an increase in raw materials and manufacturing costs, an increase in personnel related costs, and an increase in consulting and outside services, largely driven by increased headcount and mRNA-1273 clinical development. ***General and Administrative Expenses***: General and administrative expenses were $48.5 million for the three months ended September 30, 2020 compared to $28.2 million for the same period in 2019. General and administrative expenses were $109.3 million for the nine months ended September 30, 2020 compared to $83.9 million for the same period in 2019. The increases were mainly due to an increase in personnel related costs, an increase in legal related costs, and an increase in consulting and outside services. The increases were primarily attributable to increased headcount and mRNA-1273 vaccine candidate development and commercialization activities.

Net Loss: Net loss was $233.6 million for the three months ended September 30, 2020 compared to $123.2 million for the same period in 2019. Net loss was $474.6 million for the nine months ended September 30, 2020 compared to $390.7 million for the same period in 2019.

Disclaimer: The above material has no intention, in no way to provide any advice for trading of mentioned stocks. The written material it represents facts accumulated from references and my private opinion. For clarity, as of today, I own stocks of ***MRNA*** and ***PFE***. I have traded in the past ***BNTX*** stock.

Figure 5. A number of vaccines in progress as well as several of them inactivated. (Sourced from ref. 28) The vaccines from Pfizer/BioNtech/Fosun and Moderna are the closest for approval if the results from phase 3 clinical trials are successful.


Developer
Pre-clinical evaluation
Phase 1
Phase 2
Phase 3
Approved
University of Oxford/AstraZeneca Non-replicating viral vector
Gamaleya Research Institute Non-replicating viral vector
Janssen (Johnson & Johnson) Non-replicating viral vector
BioNTech/Fosun Pharma/Pfizer RNA
Moderna/NIAID RNA
Novavax Protein subunit
Bharat Biotech Inactivated
Institute of Medical Biology, Chinese Academy of Medical Sciences Inactivated
Research Institute for Biological Safety Problems Inactivated
SpyBiotech/Serum Institute of India Virus-like particles
Arcturus/Duke-NUS RNA
CureVac RNA
Cadila Healthcare DNA
Genexine Consortium DNA
Inovio/International Vaccine Institute DNA
Osaka University/AnGes/Takara Bio DNA
Anhui Zhifei Longcom/Institute of Microbiology, Chinese Academy of Sciences Protein subunit
Kentucky Bioprocessing Protein subunit
Sanofi Pasteur Protein subunit
Beijing Minhai Biotechnology Co. Inactivated
Medicago Virus-like particles
CanSino Biologics/Academy of Military Medical Sciences Non-replicating viral vector
ImmunityBio, Inc. & NantKwest Inc. Non-replicating viral vector
Ludwig-Maximilians/University of Munich Non-replicating viral vector
ReiThera Non-replicating viral vector
Vaxart Non-replicating viral vector
Beijing Wantai Biological Pharmacy/ Xiamen University Replicating viral vector
Merck Sharp & Dohme Replicating viral vector
Merck Sharp & Dohme/Themis Bioscience/Institut Pasteur Replicating viral vector
Imperial College London RNA
People's Liberation Army Academy of Military Sciences/Walvax Biotech RNA
COVAXX Protein subunit
Clover Inc./GSK/Dynavax Protein subunit
Instituto Finlay de Vacunas Protein subunit
Medigen Vaccine Biologics Protein subunit
University Hospital Tuebingen Protein subunit
University of Queensland Protein subunit
Vaxine Pty Ltd/Medytox Protein subunit
Vector Protein subunit

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