Committee on Energy and Commerce
Subcommittee on Oversight and Investigations

Hearing on "Pathway to Protection: Expanding Availability of COVID-19 Vaccines"

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Dr. Stephen Hoge, President, Moderna
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The Honorable Anne McLane Kuster (D-NH):

1. Can you speak to your reliance, if any, on foreign sources for vaccine manufacturing supplies?

The manufacturing process for Moderna's U.S. supply of its COVID-19 vaccine is domestic. Our supply chain includes a number of raw materials, some of which have been sourced internationally because they are almost exclusively produced abroad. We work to secure that supply in advance of when it is needed for production.

2. Considering the federal government's actions to date, what gaps or restrictions still exist across the domestic manufacturing supply chain and the export/import landscape that influence your decision to use foreign over domestic sources?

Moderna is grateful for the investment and efforts that the federal government has made to secure our supply chain and facilitate access to the raw materials that we need. Some of the raw materials that are used in our vaccine manufacturing process are produced almost exclusively in Europe. So while we rely on those raw materials as part of our process, the manufacturing process for our U.S. supply is located in the United States.

3. What changes should be made for you to prioritize using domestic sources?

Moderna has prioritized domestic sources where feasible. We are currently focused on protecting patients by producing our COVID-19 vaccine as efficiently as possible consistent with our commitment to high standards of quality and safety. Once we have addressed this pressing challenge, Moderna would support an assessment of the raw material supply chain and whether lessons learned from responding to this pandemic may be useful in making improvements for the future.

4. Can you speak to what constraints, including with respect to specific products within the supply chain (e.g., APIs, bioreactors, glass vials, stoppers, fills/finishers, etc.) are currently preventing the production of more vaccines?

Moderna is continually looking for ways to improve the efficiency of our manufacturing process. One of the recently identified constraints on our production has been the capacity of the fill-and-

finish process. To reduce this constraint, we studied the possibility of adding more doses to each vial of vaccine. We determined this would improve output because it allows us to complete manufacturing runs more quickly; it also reduces the need for consumable materials in high demand. The FDA recently approved our proposal to increase the amount of vaccine in each vial to allow vaccine administrators to draw up to 15 doses. This will allow us to produce and deliver more doses more quickly. We will continue to collaborate with our manufacturing partners and the federal government to increase the efficiency of our production process without compromising quality or safety.

5. Can you speak to how making the investments called for in the American Rescue Plan, like the investment in new factories, may optimize vaccine fill lines to ensure maximum efficiency to meet future demands?

At Moderna, we are currently focused on protecting patients by producing our COVID-19 vaccine as efficiently as possible consistent with our commitment to high standards of quality and safety. Moderna is grateful for the investments that the United States government made to support the ramp up of manufacturing for COVID-19 vaccine candidates and is encouraged by the government's continued partnership in the manufacturing process. We are still assessing the potential impact of the American Rescue Plan, but legislation furthering these efforts is welcome.

The Honorable Lori Trahan (D-MA)

1. T cells and antibodies are two arms of the immune system that provide insights into disease activity and an individual's personal immunity. Serology is more commonly used to measure immune responses to infections. Since antibody responses wane within 2 – 3 months of COVID-19 infection, serology alone is not enough to assess personal immunity or "herd immunity" against SARS-CoV-2. We have seen that other countries have approached vaccine approval differently than the U.S. For example, the United Kingdom established a "vaccine task force" to objectively compare the T-Cell and antibody immune response of each vaccine approved for usage in the country. Based on published reports, the UK government felt this was important to enable objective comparison across vaccine modalities. Did any of your company study T-Cell responses during the development of your vaccines?

Yes, as part of its animal studies and in the mRNA-1273 Phase I trial, Moderna studied both T-Cell and antibody-mediated immune responses to its vaccine. The vaccine generated robust responses in both arms of the adaptive immune system, including T-Cell responses that were at least equivalent to that seen in individuals who obtained immunity through a prior COVID-19 infection.

2. When thinking about expanding the availability of vaccines, one thing that is extremely important is that vaccine distribution is done in an equitable manner. Many state leaders, including those in my state of Massachusetts, tried to approach plans for vaccine distribution early on in an equitable way—they consulted with public health leaders to develop a tiered plan to equitably prioritize distribution. Due to the limited supply of

vaccines and slow distribution to the state, the implementation has heavily relied upon mass vaccination sites. While mass vaccination sites may work well for some patients, others will be best served by their own physicians, in their own communities. Physicians are a trusted source of medical information, and they can proactively reach out to their patients who need the vaccines most, including the elderly, the sick, and specifically communities of color who have been disproportionately affected by this pandemic. Mass vaccination sites, while getting the vaccine out quickly, prioritize those with access to transportation to get to the site, as well as resources to navigate the process to register for a vaccine. What role can manufacturers play in helping states get vaccines distributed to physician practices—whether by allowing smaller shipment sizes tailored to physician offices (that may only need ~50-100 vaccine doses) or creative solutions to aid in vaccine storage?

> **a. What assistance would you need from the government for this, in terms of ramping up production/manufacturing and packaging shipments in a manner tailored to physician offices?**

Under its current contract, Moderna delivers vaccines to the federal government, and the government is responsible for vaccine distribution. We have and will continue to work with the government to provide our vaccine in the format or formats that will best accommodate distribution to the American public. Moderna strongly believes that its vaccine should be distributed equitably, and that it must be a priority to afford access to individuals and communities of color, the elderly, the sick, and others who have seen greater rates of suffering and death during this pandemic.

The Honorable Morgan Griffith (R-VA)

1. What types of process improvements and innovation can lead to boosting vaccine production?

Moderna has been able to consistently scale up its production as we continue to refine our manufacturing process and gain experience in producing the vaccine. We are also continually looking for ways to improve the efficiency of our manufacturing process. For example, one of the recently identified constraints on our production process has been the capacity of the fill-and-finish process. To reduce this constraint, we studied the possibility of adding more doses to each vial of vaccine. We determined that this would improve output because it allows us to complete manufacturing runs more quickly; it also reduces the need for consumable materials in high demand. The FDA recently approved our proposal to increase the amount of vaccine in each vial to allow vaccine administrators to draw up to 15 doses. This will allow us to produce and deliver more doses more quickly. We will continue to collaborate with our manufacturing partners and the federal government to increase the efficiency of our production process without compromising quality or safety.

2. Given the variants that are circulating across the world and that we may need a booster or annual shot similar to the influenza vaccine, how quickly can your vaccine

manufacturing platform be adapted to scale up and manufacture a new or altered vaccine formula?

Moderna is encouraged by new data, which suggest that the two-dose regimen of mRNA-1273 should protect against the most widespread variants detected to date. Out of an abundance of caution, Moderna has also undertaken a two-pronged strategy to proactively address the pandemic as the virus continues to evolve: First, we are testing an additional booster dose of mRNA-1273 to study its ability to further increase immunity against emerging strains. Second, leveraging the flexibility of our mRNA technology, we are conducting a study on a variant-specific booster to see if it would be more effective at specifically neutralizing a specific variant.

One of the great benefits of mRNA technology is that it is highly adaptable. That gives us hope that we can, if necessary, quickly develop boosters to respond to emerging variants. Moderna will continue to work with federal officials and other stakeholders to monitor and identify any emerging variants of concern.

3. Has your company developed partnerships with other companies to provide your company with assistance in the vaccine manufacturing process?

Yes. In addition to operating its own manufacturing facility in Norwood, Massachusetts, Moderna has partnered with one of the world's leading contract manufacturers, Lonza, to manufacture our vaccine. Lonza has facilities in both the U.S. and Switzerland, allowing us to scale-up for production both domestically and abroad. For the fill-finish, inspection, testing, and packaging parts of our production process, we have partnered with Catalant, a contractor that specializes in this "fill-finish" step. We also recently announced that Baxter BioPharma Solutions will provide "fill-finish" services and supply packaging for approximately 60-90 million doses of the Moderna COVID-19 Vaccine in 2021.

a. Is your company looking to develop additional partnerships?

Moderna is open to additional partnerships that would allow it to further scale our manufacturing process consistent with our commitment to high standards of quality and safety.

4. Is your company utilizing, or has explored utilizing, the Department of Health and Human Services' (HHS) Centers for Innovation in Advanced Development and Manufacturing (CIADM) program to expand existing manufacturing capacity? Why or why not?

Moderna has not utilized the CIADM program because we have not required that assistance.

5. As time passes, the virus continues to mutate causing new variants to emerge. Can you explain the level of difficulty involved in creating a booster shot to provide protection against these new variants, specifically in an mRNA vaccine?

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will continue to work with federal officials and other stakeholders to monitor and identify any emerging variants of concern.

a. The current vaccination rollout has been staggered in phases due to the limited supply of COVID-19 vaccines in comparison to the high demand. There is worry that this slow, phased type of rollout will occur again should the U.S. government need to distribute booster shots to protect against the new variants. The current dose for the Moderna vaccine is 100 micrograms. Is it possible to reduce the dose of the booster shot, and if so, by how much?

Moderna is studying the possibility of using a smaller dose for a potential booster shot. We will know more about the feasibility of that approach after further study.

6. As you clinically evaluate the dosage for a booster shot to provide protection against new variants, do you have any projections for the necessary dose in these booster shots? How will this estimated dosage affect production capacity?

Moderna is studying the possibility of using a smaller dose of 50 μg for a potential booster shot. We will know more about the feasibility of that approach after further study. It is possible that a smaller dose size would increase the speed at which Moderna is able to produce vaccine doses.

The Honorable Michael C. Burgess, M.D. (R-TX)

1. One of the greatest inhibitors of distributing the COVID-19 vaccine to rural areas is the lack of cold-chain technologies to store the RNA vaccine. Additionally, as we consider logistics in distributing the vaccine abroad to third-world countries where power may not be available, the Moderna or Pfizer vaccine may not be an option. Are Moderna or Pfizer conducting any research on ways to incorporate new technologies to make the RNA vaccines stable to store at room temperature to allow for broader distribution?

Moderna recently began clinical trials of our next-generation COVID-19 candidate. This is a potential refrigerator-stable ready-to-use vaccine in liquid state that could facilitate easier distribution and administration in a wider range of settings, including potentially for rural communities and developing countries. We also recently obtained authorization from the FDA for our vaccine to be kept at room temperature conditions for 24 hours, an increase from the previous 12 hours. The FDA also authorized a punctured vial to be used for up to 12 hours, an increase from the previous 6 hours. We remain committed to investigating options to help solve this public health emergency.

The Honorable Billy Long (R-MO)

1. What are you doing to evaluate and incorporate technology to make vaccines stable at room temperature so they can be more widely distributed, especially if we are faced with annual vaccination efforts against COVID-19 as suggested by some experts? Additionally, are you aware the Infectious Disease Research Institute, located in Washington State, has pioneered technology that allows RNA vaccines to be freeze-dried and stored nearly a year

at room temperature or 2 years under simple refrigeration. It's my understanding that this technology, once approved, could be applied to the Pfizer and Moderna vaccines to ensure long-term stability. Is this a technology your company would consider exploring?

Moderna does employ its own freeze-dried technology, called lyophilization, in other vaccines in clinical development. But in part because the lyophilization process is time-consuming, Moderna determined that developing a next-generation candidate is a superior approach for the current COVID-19 crisis. Moderna recently began clinical trials of its next-generation COVID-19 candidate, a potential refrigerator-stable ready-to-use vaccine in liquid state that could facilitate easier distribution and administration in a wider range of settings, including potentially for rural communities and developing countries. As circumstances evolve, we will continue to pay close attention to this issue and will consider a range of possible solutions.

The Honorable Neal P. Dunn, M.D. (R-FL)

1. In addition to your heroic efforts in vaccine development, are your companies also engaged in research and development of therapeutics? That is to say anti-virals that could potentially have a broader spectrum of activity across the coronavirus variants?

Moderna is engaged in the research and development of therapeutics. Moderna has 23 development candidates across a range of infectious diseases and therapeutic areas. Moderna is not currently developing any anti-virals related to the COVID-19 or variants.