NATIONAL GOVERNORS ASSOCIATION

M E M O R A N D U M

May 28, 2020

To: Governors' Offices
From: National Governors Association
Subject: Update on COVID-19 Vaccine Development and Production

Achieving broad immunity to COVID-19 is central to a return to normal life, and most experts maintain that this hinges on a widely available, safe and effective vaccine. A global race to develop and manufacture promising vaccine candidates is well underway. Several national and global collaborations, including multiple public-private partnerships initiated by the Trump Administration, are harnessing government, industry and academic assets to spur development. Efforts are aiming to a) accelerate research on the safety and efficacy of multiple candidate vaccines, b) smooth regulatory pathways toward licensure and distribution, and c) prepare for mass production. These efforts and others are supported by substantial financial investments from governments, philanthropists, and industry. In the United States, Congress has directed almost $10 billion to research and countermeasure development through supplemental funding. Federal agencies have also leveraged ongoing research and shifted existing investments and resources to support COVID-19 countermeasures development and production efforts. Both known and novel approaches to vaccine development are being investigated. As of May 20, 140 vaccines are in the global development pipeline and at least eight are in active clinical trials, according to the Milken Institute COVID-19 Treatment and Vaccine Tracker, which is one of several trackers following candidates (all with slightly different numbers depending on methodology). Other trackers include: ClinicalTrials.gov, World Health Organization, BIO, Bioworld, Aris Ventures, Oxford.

While the timeframe for broad availability of a safe and effective vaccine is not clear, some suggest a COVID-19 vaccine could be available for emergency use for certain populations (such as health care workers) before the end of 2020, and collaborators are signaling mass production capacity by early 2021. Below is a high-level summary of major collaborations working on vaccine development and manufacturing, an explanation of the accelerated development processes, and the latest on clinical trials in humans.

Major National and Global Collaborations

The National Institutes of Health's (NIH) Public-Private Partnership -- Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV). The ACTIV partnership includes federal agencies and departments: the NIH; the Department of Health and Human Services (HHS), the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), Biomedical Advanced Research and Development Authority (BARDA), the Departments of Defense (DOD) and the Department of Veterans Affairs (VA), and the Foundation for NIH, as well as more than 15 biopharmaceutical companies, academics, philanthropic organizations, and the European Medicines Agency. The partnership focuses on building consensus on vaccine trial designs, rapid data sharing, and alignment among public and private sectors to efficiently conduct vaccine efficacy studies.

Operation Warp Speed. On May 15, the Trump Administration announced the framework and leadership for this public-private partnership to facilitate development, manufacturing and distribution of COVID-19 countermeasures including vaccines. Partners include HHS programs: CDC, FDA, NIH and BARDA, along with the DOD, Department of Agriculture, Department of Energy and the VA. Operation Warp Speed will coordinate with other efforts within the administration and includes three focus areas for accelerating the timeframe for countermeasures: development, manufacturing and distribution. The announcement highlighted regular public updates on progress and a commitment to affordability, with companies receiving support

committing to providing a donated allocation of countermeasures. Of the original fourteen promising candidates already chosen (but not named), ultimately three to five will go through large-scale randomized trials for safety and efficacy.

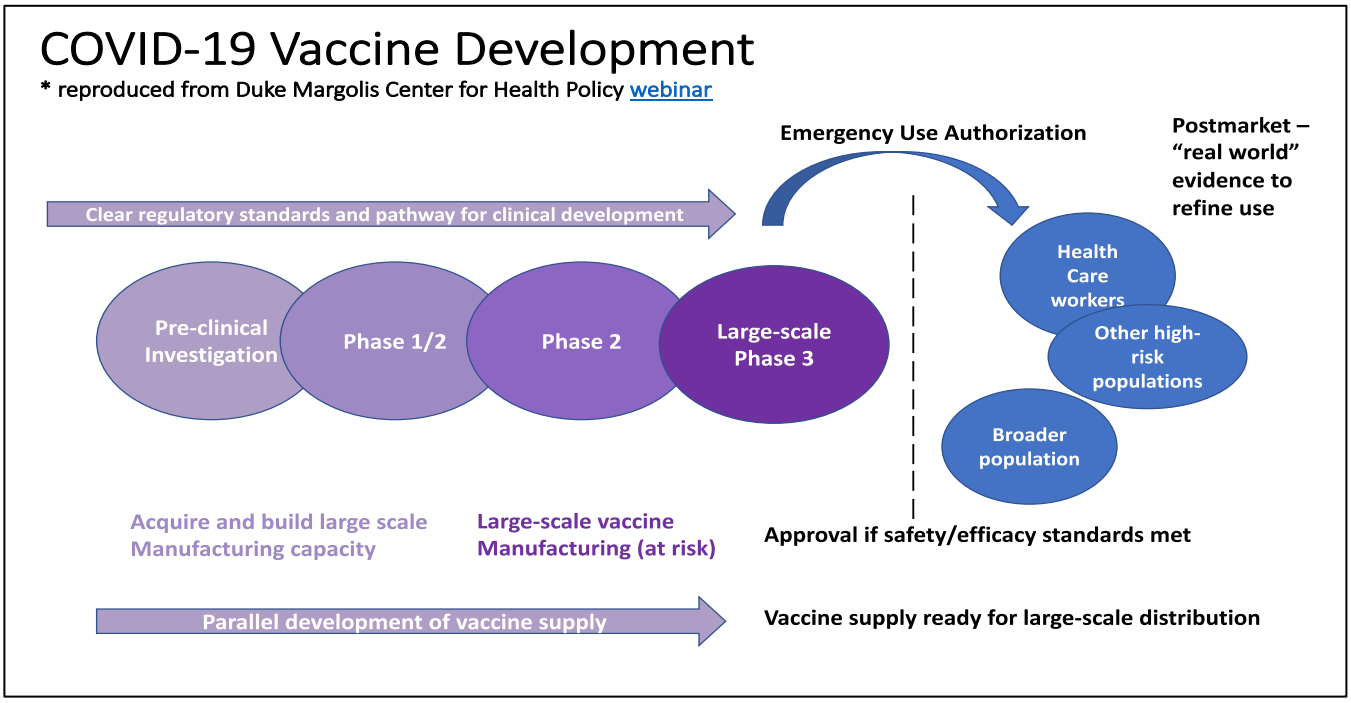
The World Health Organization (WHO). The WHO is directing and coordinating international efforts to develop and evaluate vaccines by a) facilitating collaboration among scientists, developers, and funders; b) mapping candidate vaccines and their progress; c) producing a set of minimum desired attributes of safe and effective vaccines; and d) coordinating clinical trials across the world. On April 24, the WHO, French President Emmanuel Macron, German Chancellor Angela Merkel and the Bill and Melinda Gates Foundation cohosted a virtual event to launch an $8 billion drive to accelerate development of a COVID-19 vaccine, tests and treatments.

The Coalition for Epidemic Preparedness Innovations (CEPI). CEPI is a global partnership of public, private, philanthropic and civil organizations formed in 2017 to develop vaccines to stop future pandemics. Specifically, CEPI advances vaccine development through proof-of-concept to human testing and establishes vaccine stockpiles in preparation for epidemics; funds new and innovative platform technologies; and coordinates activities to improve collective response to epidemics. In coordination with the WHO, CEPI has initiated nine partnerships that leverage existing platforms to rapidly advance COVID-19 vaccine candidates to clinical trials.

Scientists to Stop COVID-19. The collaborative comprises a group of "citizen scientists" specializing in chemical biology, epidemiology, neurology, oncology, nuclear science, and investors. They are pursuing four proposals to quickly produce safe and effective COVID-19 therapeutics and vaccines and reopen society with limited risk. Notably, all contributing scientists have declared no direct or known indirect financial interests in companies referenced in their proposals.

Accelerated Vaccine Development and Preparation for Mass Production

Efforts to accelerate vaccine availability is reliant upon a compressed development process. The figure below (reproduced from the Duke-Margolis Center for Health Policy webinar) identifies the concurrent steps of clinical investigation, regulatory standard development, and manufacturing capacity needed to expedite development. From a clinical investigation standpoint, the typically sequential phases of clinical trials (e.g. safety and efficacy



phases), are now being conducted in an overlapping manner (as depicted by the overlapping ovals across the clinical phases). At the same time, regulators are developing a clear regulatory pathway and manufacturing capacity is being built to immediately begin production when clinical phases are complete. Manufacturing capacity is being built "at risk" with full knowledge that production will begin on promising candidates that may ultimately fail. Regardless, many of these efforts are preparing to produce millions of doses quickly. There are a number of questions around how vaccine(s) will be distributed when available given the general view that supply will not meet demand early on. Some collaborators are emphasizing equitable distribution as a central tenet and others argue that economic forces may prevail, and the country of vaccine origin may disproportionately benefit. In the short term, if Phase 3 trials look promising, emergency use may be authorized by FDA for one or more safe and efficacious candidates for high priority groups (e.g., health care providers), with more widescale availability after more evidence of effectiveness is produced.

Latest Developments: Vaccines in Clinical Trials

China. Five vaccines for COVID-19 are in Phase 2 human trials in China. Results are expected in July according to reports of a press briefing by the vice minister of the Chinese National Health Commission.

Moderna. On May 18, Moderna announced promising interim data from its Phase 1 study, led by NIH's National Institute of Allergy and Infectious Diseases. The data suggest the experimental vaccine is generally safe and able to stimulate an immune response against the virus. The company is preparing for Phase 2/3 studies with Phase 3 expected to launch in July. Funding from the BARDA supported study planning and will support late-stage clinical development, and scaling of manufacturing.

Inovio. On May 20, Inovio announced the publication of a peer-reviewed study in the journal Nature Communication demonstrating that its vaccine candidate (INO-4800) generated robust neutralizing antibodies and an immune response against the virus causing COVID-19. They further reported that data from their Phase 1 clinical trial on safety and efficacy with healthy volunteers and animal challenge trials are expected in June which will lead into Phase2/3 clinical trials in the summer. The company has assembled a coalition of collaborators and manufacturers across the globe and expects to produce 1 million doses by the end of the year.

Oxford and AstraZeneca. On May 21, HHS announced an up to $1.2 B investment in further development and manufacturing of the AstraZeneca (AZD-1222) vaccine candidate licensed from developers at Oxford University Jenner Institute. Under this public-private partnership, BARDA can provide funding support for advanced clinical studies, vaccine manufacturing technology transfer, process development, scaled-up manufacturing and other development activities. The goal is to make available at least 300 million doses of the vaccine as early as October 2020. During the week of April 24, the Oxford Vaccine Center began a randomized controlled trial with healthy adult volunteers to determine the safety and efficacy of its vaccine candidate, which is now licensed to AstraZeneca, a UK-based biopharmaceutical company, for further development, large-scale manufacturing and potential distribution of the vaccine if it is successful. Under the agreement, AstraZeneca will work with global partners on the international distribution of the vaccine, with special focus on availability for low and medium income countries, in addition to providing access to the UK. According to the announcement, both partners will operate on a not-for-profit basis for the duration of the coronavirus pandemic, with only the costs of production and distribution being covered.

Pfizer and BioNTech. On May 5, the first healthy volunteers in the U.S. received an experimental vaccine by Pfizer Inc and German company, BioNTech, as part of a global COVID-19 vaccine development program. The program includes simultaneous study of the safety, degree of immune response and dosing requirements of four vaccine candidates. The companies are also preparing to ramp up manufacturing for global supply in anticipation of an effective candidate and are projecting production of millions of doses in 2020 and hundreds of millions in 2021.