Annexe 1. Les projets vaccinaux aux Etats-Unis

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LES PROJETS DE R&D VACCINAUX EN ESSAIS CLINIQUES DE PHASE I EN COURS

1. MODERNA / NIAID NCT NUMBER: NCT04283461

Title: Safety and Immunogenicity Study of 2019-nCoV Vaccine (mRNA-1273) for Prophylaxis of SARS-CoV-2 Infection (COVID-19)

Interventions: Biological: mRNA-1273

Sponsor/Collaborators: National Institute of Allergy and Infectious Diseases (NIAID)

Phases: Phase 1

Funded Bys: NIH

Study Type: Interventional

Study Designs: Allocation: Non-Randomized|Intervention Model: Sequential Assignment|Masking: None (Open Label)|Primary Purpose: Prevention

Start Date: March 16, 2020

Locations: Emory Vaccine Center - The Hope Clinic, Decatur, Georgia, United States|National Institutes of Health - Clinical Center - Vaccine Research Center Clinical Trials Program, Bethesda, Maryland, United States|Kaiser Permanente Washington Health Research Institute - Vaccines and Infectious Diseases, Seattle, Washington, United States

URL: https://ClinicalTrials.gov/show/NCT04283461

2. BIONTECH / PFIZER - NCT NUMBER: NCT04368728

Title: Study to Describe the Safety, Tolerability, Immunogenicity, and Potential Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Adults

Interventions: Biological: BNT162a1|Biological: BNT162b1|Biological: BNT162b2|Biological: BNT162c2|Other: Placebo

Sponsor/Collaborators: Biontech SE|Pfizer

Phases: Phase 1|Phase 2

Funded Bys: Industry

Study Type: Interventional

Study Designs: Allocation: Randomized|Intervention Model: Parallel Assignment|Masking: Triple (Participant, Care Provider, Investigator)|Primary Purpose: Prevention

Start Date: April 29, 2020

Locations: University of Maryland General Clinical Research Center, Baltimore, Maryland, United States|University of Maryland Medical Center Investigational Drug Service Pharmacy, Baltimore, Maryland, United States|University of Maryland, Center for Vaccine Development and Global Health, Baltimore, Maryland, United States|NYU Langone Health, New York, New York, United States

URL: https://ClinicalTrials.gov/show/NCT04368728

3. INOVIO / CEPI - NCT NUMBER: NCT04336410

Title: Safety, Tolerability and Immunogenicity of INO-4800 for COVID-19 in Healthy Volunteers

Interventions: Drug: INO-4800|Device: CELLECTRA® 2000

Sponsor/Collaborators: Inovio Pharmaceuticals|Coalition for Epidemic Preparedness Innovations (CEPI)

Phases: Phase 1

Funded Bys: Industry|Other

Study Type: Interventional

Study Designs: Allocation: Non-Randomized|Intervention Model: Sequential Assignment|Masking: None (Open Label)|Primary Purpose: Prevention

Start Date: April 3, 2020

Locations: Center for Pharmaceutical Research, Kansas City, Missouri, United States|University of Pennsylvania, Philadelphia, Pennsylvania, United States

URL: https://ClinicalTrials.gov/show/NCT04336410

4. Baylor College / Anderson Cancer Center / Harvard - NCT Number: NCT04348370

Title: BCG Vaccine for Health Care Workers as Defense Against COVID 19

Conditions: Coronavirus|Coronavirus Infection|Coronavirus as the Cause of Diseases Classified Elsewhere

Interventions: Biological: BCG Vaccine|Biological: Placebo Vaccine

Sponsor/Collaborators: Texas A&M University|Baylor College of Medicine|M.D. Anderson Cancer Center|Cedars-Sinai Medical Center|Harvard University

Phases: Phase 4

Funded Bys: Other

Study Type: Interventional

Study Designs: Allocation: Randomized|Intervention Model: Parallel Assignment|Masking: Double (Participant, Investigator)|Primary Purpose: Prevention

Start Date: April 20, 2020

Locations: Cedars-Sinai Medical Center, Los Angeles, California, United States|Harvard T.H. Chan School of Public Health, Boston, Massachusetts, United States|Texas A&M Family Care Clinic, Bryan, Texas, United States|Baylor College of Medicine, Houston, Texas, United States|Baylor St. Luke's Medical Center, Houston, Texas, United States|Harris Health System - Ben Taub Hospital, Houston, Texas, United States|MD Anderson Cancer Center, Houston, Texas, United States

URL: https://ClinicalTrials.gov/show/NCT04348370

LISTE PARTIELLE DES PROJETS DE RECHERCHE VACCINAUX IDENTIFIES AUX ETATS-UNIS

mRNA Vaccine

1. *Moderna //US + éventuel projet en France*

Treatment: mRNA-1273

Type: Novel lipid nanoparticle (LNP)-encapsulated mRNA vaccine encoding for a perfusion stabilized form of the Spike (S) protein.

April 14, 2020 – Données préliminaires de safety de vaccin à ARN contre le virus ZIKA - données provisoires de son essai clinique de phase 1 testant l'ARNm-1893, un vaccin contre le virus Zika. La dose de 10 microgrammes du vaccin a produit un taux de séroconversion -- les patients passant de l'absence d'anticorps au virus à la présence d'anticorps -- de 94,4%. Plus impressionnant encore, les 23 patients traités avec la dose de 30 microgrammes ont tous eu une séroconversion. Moderna a également testé le vaccin sur des patients qui avaient déjà des anticorps contre le virus Zika : 50% des patients ayant reçu la dose de 10 microgrammes et 75% des patients ayant reçu la dose de 30 microgrammes ont montré une multiplication par quatre des anticorps après la deuxième vaccination.

March 16, 2020 - Moderna on March 16 reportedly was to dose the first patient in a Phase I open-label, dose-ranging trial of mRNA-1273 (NCT04283461), occurring at Kaiser Permanente Washington Health Research Institute in Seattle. The study will assess the safety and reactogenicity of a 2-dose vaccination schedule of mRNA-1273, given 28 days apart, across 3 dosages in healthy adults. The first batch of mRNA-1273 was shipped in February to the NIH's National Institute of Allergy and Infectious Diseases (NIAID) Vaccine Research Center (VRC), with partnered with Moderna in designing the vaccine.

2. *Sanofi, Translate Bio // FR Lexington MA*

Mar 27, 2020 Sanofi Pasteur, the vaccines business for French pharma giant Sanofi, and Massachusetts-based Translate Bio have partnered to develop a novel messenger RNA (mRNA) vaccine for COVID-19, the disease caused by the novel coronavirus. The two companies are building on a two-year-old partnership to develop mRNA vaccines for infectious diseases. Translate Bio and Sanofi Pasteur have already generated "encouraging preclinical data across multiple infectious disease targets" through the existing collaboration. That work will serve as a strong foundation in developing a vaccine candidate for COVID-19.

NOTE : In February, Sanofi forged a collaboration with the Biomedical Advanced Research and Development Authority (BARDA) to advance a novel COVID-19 vaccine candidate. The agreement with BARDA calls for Sanofi to initiate the development of a recombinant, protein-based vaccine candidate against COVID-19.

3. *Arcturus and Duke-NUS // San Diego*

May 4, 2020 - **Arcturus Therapeutics** and **Catalent** partnered to support the manufacture of Archturus's COVID-19 mRNA vaccine candidate (LUNAR-COV19). The project uses Archturus's self-transcribing and replicating mRNA (STARR) technology and its LUNAR lipid-mediated delivery to produce low dose, potentially single shot COVID-19 vaccine. They will use Catalent's drug manufacturing facility in Madison, Wisconsin, to support human clinical trials, and if successful, commercialization of the vaccine.

April 09, 2020 - Arcturus Therapeutics Announces Clinical Trial Timeline for its COVID-19 Vaccine : **GMP-Manufactured Batch to be Delivered in June 2020 - Human Dosing Expected to Begin in Summer 2020**

Arcturus Therapeutics announced plans to initiate a human clinical trial this Summer for its COVID-19 vaccine, also known as LUNAR-COV19. Under the guidance of the Singapore Health Sciences Authority (HSA), the trial plans to enroll up to 76 healthy volunteer adults including elderly individuals, with follow-up over several months to evaluate extent and duration of immune response.

LUNAR-COV19 is a very low dose, potential single-shot (i.m.), self-replicating mRNA vaccine that is devoid of any viral material or co-adjuvants. Utilizing Arcturus processes, the mRNA vaccine product is readily manufactured, with the initial GMP batch to be delivered in June. Preclinical in vitro data shows that administration of LUNAR-COV19 generates effective expression of the COVID-19 virus spike protein – the antigen to which protective antibodies will be formed.

Mar 27, 2020. Arcturus Therapeutics provided details about the Company's strategy to rapidly learn about the safety and efficacy profile of its COVID-19 vaccine using Duke-NUS' genetic correlation system.

Duke-NUS, the Company's partner, developed a process to track genetic changes and their correlations that augment testing of vaccines. There are specific gene changes that correlate directly with efficacy, particularly the level of neutralizing antibody titers. There are also specific gene changes that correlate with safety-related adverse events, such as headache and fever. Prior studies have shown these changes correlate with longer term outcomes. These gene expression changes can be measured within the first 5 days following vaccination and the data may also guide dose selection.

4. *CureVac // Allemagne + sujet US-Trump*

Type: mRNA-based coronavirus treatment based on company's vaccine platform.

April 2, 2020. CureVac AG, a clinical stage biopharmaceutical company pioneering the field of mRNA-based drugs, announced that Jean Stéphenne, former deputy Chairman of the Supervisory Board, has been appointed as the new Chairman with immediate effect.

CureVac on March 17 told reporters in a telephone briefing that it was committed to launching animal trials of its mRNA-based COVID-19 vaccine in April, and clinical trials in humans by early summer. The update came a day after the European Commission offered up to €80 million ($88 million) toward scaling up development and productions of the vaccine. The Coalition for Epidemic Preparedness Innovations (CEPI) awarded the company up to $8.3 million in January for accelerated vaccine development, manufacturing and clinical tests.

During the briefing and in a statement two days earlier, CureVac denied a report in the German newspaper Welt am Sonntag that the administration of President Donald Trump sought to lure German-based CureVac to the U.S. with funding to produce its vaccine exclusively for the U.S. market after then-CEO Dan Menichella visited the White House March 2 with other biopharma executives, while Germany's government pressed for the company to stay in Tübingen and produce its vaccine for Germany and Europe.

U.S. ambassador to Germany, Richard Grenell denied the report via Twitter, but an unnamed German Health Ministry spokeswoman confirmed Germany's interest in CureVac developing vaccines there in a statement to Reuters. Menichella resigned on March 11, and was succeeded by former CEO and founder Ingmar Hoerr, who just five days later took a temporary leave of absence for medical reasons "not caused by coronavirus," the company said.

5. *BioNTech, Pfizer, and Fosun Pharma // Allemagne, essai clinique aux US aussi*

Treatment: BNT162

Type: Potential first-in-class mRNA vaccine designed to induce immunity and prevent COVID-19 infection

May 5, 2020 - Pfizer and BioNTech have begun dosing participants in a U.S. clinical trial of their COVID-19 vaccine candidates. The dose-escalation stage of the trial will enroll up to 360 subjects, initially out of sites in New York and Maryland. A study of the vaccine candidate, BNT162, in BioNTech's home country of Germany completed dosing of its first cohort of subjects late last month, less than a week after giving the shot to the first of the 12 people enrolled in the arm. Now, BioNTech and Pfizer have brought the development program stateside, working with researchers at NYU Grossman School of Medicine and the University of Maryland School of Medicine to test the vaccine. The U.S. clinical trial is studying four variants of the vaccine, code-named a1, b1, b2 and c2, to quickly determine which combination of mRNA format and target antigen holds the most promise. Pfizer and BioNTech are assessing candidates that contain uridine-containing mRNA, nucleoside-modified mRNA or self-amplifying mRNA.

March 17, 2020 - BioNTech and Pfizer on said they will partner to develop BNT162, which BioNTech announced individually just a day earlier—the first treatment to emerge from its accelerated COVID-19-focused development program, "Project Lightspeed." The companies said they expect to begin clinical testing for BNT162 in April as part of a global clinical development program in Europe (commencing in Germany), the U.S. and China, to be carried out at multiple sites in the U.S. and Europe. BioNTech and Pfizer said financial terms, and details of development, manufacturing, and potential commercialization will be finalized over the next few weeks. BioNTech is also partnering with Fosun Pharma to jointly develop BNT162 in China, with Fosun agreeing to make a $50 million equity investment for 1,580,777 ordinary shares in BioNTech, and pay BioNTech up to $85 million in additional upfront and milestone payments. The companies will share future gross profits from the sale of the vaccine in China.

Also partnered with the University of Pennsylvania and the Bill and Melinda Gates Foundation; agreed with Pfizer to co-develop and distribute the vaccine outside of China

DNA Vaccine

6. Inovio Pharmaceuticals and Beijing Advaccine Biotechnology // Pennsylvania

Treatment: INO-4800

Type: DNA Vaccine

Apr 7, 2020 - Human testing beginning on second coronavirus vaccine candidate after approval from the Food and Drug Administration, Inovio Pharmaceuticals announced Monday.

The company said the first phase of clinical testing is set to begin this week with a study of 40 healthy adult volunteers. Each participant will receive two doses of the drug, INO-4800, four weeks apart. The initial immune responses and safety data from the study are expected by late summer, according to Inovio. The drug is a DNA vaccine that is designed to prevent COVID-19 infection. Inovio said the preclinical results for the potential COVID-19 vaccine are consistent with a completed phase one vaccine study for MERS, which is also caused by a coronavirus.

Inovio said it plans to head into a second phase of the study "as rapidly as possible" and said thousands of doses of the drug have been manufactured to support ongoing phase one and phase two trials.

Inovio on March 12 said it received a $5 million grant from the Bill and Melinda Gates Foundation to accelerate testing and scale-up of CELLECTRA® 3PSP, a hand-held smart device for the intradermal delivery of INO-4800 that runs on AA batteries. Inovio is partnering with Beijing Advaccine Biotechnology on a Phase I trial in China in parallel with the company's clinical development efforts in the U.S. to develop INO-4800 as a coronavirus treatment.

Inovio said January 30 it will leverage Beijing Advaccine Biotechnology's expertise to run a Phase I trial in China in parallel with the company's clinical development efforts in the U.S. to develop INO-4800 as a coronavirus treatment. Inovio has said it will develop INO-4800 through Phase I testing in the U.S., and has launched preclinical testing for clinical product manufacturing. INO-4800 development is also supported by $9 million grant from the Coalition for Epidemic Preparedness Innovations (CEPI).

7. LineaRx (Applied DNA Sciences) and Takis Biotech // US + Rome

Treatment: Linear DNA vaccine

Type: To be based on PCR-produced linear DNA designed to induce antibodies that can neutralize SARS-CoV-2. Four preclinical vaccines have been designed based on the structure of the "Spike" protein, which enables uptake of the coronavirus by binding to specific receptors on the host cells.

Apr 02, 2020 - STONY BROOK, N.Y., & ROME--(BUSINESS WIRE)--Applied DNA Sciences, a leader in Polymerase Chain Reaction (PCR)-based DNA manufacturing and Takis Biotech a company focused on the development of cancer vaccines and founded by scientists from Merck Research Laboratories, today announce an expansion of their COVID-19 vaccine development program to include a fifth vaccine candidate. Production of all vaccine candidates is expected to be completed this month at Applied DNA's LinearDNA™ production facility in Stony Brook, N.Y. All vaccine candidates have also been approved by Italy's Ministry of Health for preclinical animal testing that is scheduled to begin in late April 2020. "The newly added 5th linear DNA vaccine candidate encodes an engineered fusion protein of a COVID-19 Spike domain with an immunomodulator moiety," indicated Dr. Luigi Aurisicchio, CEO and CSO of Takis Biotech. Concurrent with the Takis animal trials, Applied DNA will prepare for cGMP production of selected vaccine candidate(s) to support human trials scheduled to begin this fall."Under the terms of the companies' amended Joint Development Agreement, Takis will use the scaled-up LinearDNA synthetic genes produced by Applied DNA for each of the five putative vaccines to inoculate mice whose sera will be tested for the presence of antibodies that bind to the purified Spike proteins. Those positive candidates that bind to Spike will be tested for their ability to neutralize COVID-19 by preventing uptake of the virus in cells in culture and in animal models.

The potential advantages posed by PCR-produced LinearDNA vaccines, as opposed to the circular DNA obtained from more traditional plasmid sources, include the speed of production, the absence of antibiotics and their resistance genes, the purity of the DNA, the simplicity of design, the powerful immunogenicity proven in a prior LinearDNA vaccine preclinical study, the absence of any bacterial contaminants and the fact that the vaccine gene is effective without insertion into the patient's genome.

Takis expects preclinical testing results in April 2020; their final vaccine candidate could begin human testing by fall, according to a company press release.

Applied DNA Sciences said March 4 that four DNA vaccine candidates will be produced this month for preclinical animal testing via the company's proprietary PCR-based DNA ("LinearDNA") manufacturing systems. "Within weeks of arrival we expect to immediately scale up PCR-based

production of each vaccine candidate and ship them back to Takis who will determine each vaccine's relative abilities to provoke an immune response in vaccinated mice" stated James A. Hayward, president and CEO of Applied DNA and LineaRx. Takis Biotech received approval from the Italy's Ministry of Health to begin a preclinical trial of a COVID-19 vaccine candidate with first results expected in April 2020

Applied's majority-owned subsidiary LineaRx and Rome-based Takis Biotech said February 7 they had formed a joint venture to develop the preclinical vaccine using PCR-based DNA manufacturing technology. The companies said advantages of their technology include the speed of production, the absence of antibiotics and their resistance genes, the purity of the DNA, the simplicity of design, the powerful immunogenicity proved in a prior linear DNA vaccine, the absence of any bacterial contaminants and the effectiveness of the vaccine gene without insertion into the patient's genome.

Atténué – Measles live-attenuated

8. Institute Pasteur, University of Pittsburgh, Themis // FR + US + Austria

April 15, 2020 - France's Pasteur Institute is trying to use a modified measles vaccine to "trick" the body into producing antibodies against SARS-CoV-2. They indicate they hope it will stimulate an immune response similar to the current MMR vaccine that protects against measles, mumps, and rubella. It is partnered with the University of Pittsburgh's Centre for Vaccine Research and believes it can begin animal testing within a few months, with Austrian biotech company Themis manufacturing the vaccine for clinical trials. https://www.sciencealert.com/scientists-use-the-measles-vaccine-to-develop-trojan-horse-against-covid-19

The institute sequenced the whole genome of COVID-19 in January and is researching treatments and vaccines; ; it is engineering measles live-attentuated vaccine to express other antigens.

live horsepox virus vaccine

9. Tonix Pharma/Southern Research // NY

Southern Research announced today that it has entered into a strategic collaboration with New York-based Tonix Pharmaceuticals Holding Corp., a clinical-stage biopharmaceutical company, to support the development of a vaccine, TNX-1800, against the new coronavirus disease, COVID-19, based on Tonix's proprietary horsepox vaccine platform.

Tonix is developing TNX-801 – a live horsepox virus vaccine for percutaneous administration — as a potential smallpox preventing vaccine for the U.S. strategic national stockpile and as a vaccine against monkeypox. Tonix's proprietary horsepox virus has the potential to serve as a vector for vaccines to protect against other infectious agents. Southern Research and Tonix said the new research collaboration will develop and test a potential horsepox vaccine that expresses protein from the virus that causes COVID, a SARS-CoV-2, to protect against the disease.

rabies vaccine

10. Thomas Jefferson University // Pennsylvania

Apr 8, 2020 - Thomas Jefferson University, is to speed bioproduct manufacturing by piggy-backing new vaccines or therapeutics onto organisms and techniques that already are in commercial production. With this approach, safety profiles are largely known and manufacturing techniques are well-understood. That's the approach Thomas Jefferson University developers are taking with Coravax™, a shelf-stable vaccine candidate. Coravax is made from the spike protein from the current coronavirus (SARS-COV-2). That is the portion of the virus most likely to generate a protective immune response. "It is then combined with a killed rabies vaccine that serves as a carrier of sorts. When vaccinated, a person would develop antibodies against both rabies and the coronavirus spike protein. Many vaccines today are prepared by using another vaccine as a 'carrier' for the virus of interest. The benefit is that the 'carrier' vaccine already has been rigorously tested and shown to be safe and effective,"

"There are already at least 20 manufacturing facilities around the world churning out some 100 million doses a year of the rabies vaccine," he continued. "They have the means and know-how to produce this vaccine already. We're adding one small component," thereby leveraging that efficiency and safety record. Piggy-backing on a rabies vaccine also enables relatively low-cost production, which is important for a vaccine that may need to be available to billions of people. Shelf-stability is another benefit of this approach. Some vaccines require minus 80 degree centigrade freezer storage, limiting their use in remote areas. By contrast, the rabies vaccine can be produced in a shelf-stable, dehydrated form that is easy to reconstitute anywhere. "We've already begun safety testing of the CORAVAX™ vaccine in animals, and we know that the rabies vaccine has an excellent safety profile," "That vaccine is safe in children, pregnant women, across diverse populations and often generates life-long protection."

In another encouraging sign, Schnell's group previously demonstrated safety with a rabies vaccine for other coronaviruses that are highly similar to SARS-CoV-2. The group's vaccines for the coronaviruses that caused the 2003 SARS and the 2012 MERS epidemics was proven safe and effective in animal models of those diseases.

Jefferson already is in discussions with a large vaccine manufacturer about a potential partnership. The next steps are to complete animal tests and move into phase I clinical trials for safety in people.

Non-replicating viral vector

11. *Altimmune , University of Alabama at Birmingham // Maryland*

Treatment: Single-dose, intranasal vaccine designed to provide systemic immunity

Type: Vaccine based on Altimmune's proprietary platform vaccine technology, which the company applied in developing NasoVAX, the company's influenza vaccine candidate that showed positive Phase IIa results.

April 2, 2020 : Altimmune, Inc. and the University of Alabama at Birmingham will collaborate on the development of a single-dose, intranasal COVID-19 vaccine, called AdCOVID. It is expected that AdCOVID has the potential to activate multiple arms of the immune system as shown in a recent Phase II clinical study with NasoVAX, an influenza vaccine candidate based on the same platform technology, the company said.

Altimmune said February 28 that it completed the design and synthesis of the vaccine, and was advancing it toward animal testing and manufacturing. Clinical testing of the vaccine could start as early as August. The company also said it was "actively engaged in discussions with a number of potential partners."

12. *GeoVax/BravoVax// Atlanta + Chine*

January 27, 2020 - GeoVax Labs, Inc. (OTC: GOVXD), a biotechnology company developing human immunotherapies and vaccines against infectious diseases and cancer, together with BravoVax, a vaccine developer in Wuhan, China, today announced the signing of a Letter of Intent to jointly develop a vaccine against the new coronavirus (known as 2019-nCoV).

by March 18, 2020, it had designed, constructed and conducted in vitro characterization on three candidates, which it will narrow down to one for manufacturing and initial human testing

Under the collaboration, GeoVax will use its MVA-VLP vaccine platform and expertise to design and construct the vaccine candidate using genetic sequences from the ongoing coronavirus outbreak originating in Wuhan, China. BravoVax will provide further development, including testing and manufacturing support, as well as direct interactions with Chinese public health and regulatory authorities.

13. *Greffex // Aurora Colorado*

Texas-based genetic engineering firm Greffex claims to have developed a vaccine for the coronavirus. The company will soon begin testing it on animals to meet licensing requirements.

Greffex CEO John Price told Fox News the company was "confident in the quality of the vaccine," but that next steps depended on "what the government wants to do in terms of testing."

The company received an $18.9M U.S. government contract in October 2019 to use its Grevac Plug-and-Play technology to produce vaccine candidates for biodefense and emerging infectious diseases

14. Vaxart and Emergent BioSolutions // Californie + Rockville, MD

Treatment: Vaccine based on proprietary VAAST™ Platform

Type: Oral recombinant vaccine administered by tablet

March 30, 2020 - Vaxart produced 5 COVID-19 vaccine candidates for testing in its preclinical models. The development has started on its development program for cGMP production of the vaccine with Emergent BioSolutions and expects to initiate a Phase I trial in the second half of 2020

Vaxart on March 9 agreed to use the “molecule-to-market” contract development and manufacturing (CDMO) services of Emergent BioSolutions toward developing and manufacturing Vaxart’s experimental oral vaccine candidate for COVID-19. Development services will begin immediately, and upon Vaxart’s election, Emergent is expected to produce bulk cGMP vaccine allowing Vaxart to initiate a Phase I clinical study early in the second half of 2020. Emergent said it will provide development services out of its Gaithersburg, MD location and manufacture drug substance at its Bayview facility in Baltimore, designated a Center for Innovation in Advanced Development and Manufacturing (CIADM) by the U.S. Department of Health and Human Services.

Vaxart disclosed in January that it plans to generate vaccine candidates based on the published genome of SARS-nCoV-2, and evaluate them in preclinical models based on their ability to generate both mucosal and systemic immune responses.

Virus Like Particle

15. iBio and Beijing CC-Pharming //Delaware + China + Texas

Treatment: Vaccine for preventing infection from SARS-CoV-2

Type: Plant-derived vaccines SARS-CoV-2 Virus-Like Particle ("VLP")-based constructs manufactured using iBio's FastPharming System™, designed to produce the nanoparticles in, and purify them from, plants.

March 26, 2020 : iBIO announced that immunization studies for its SARS-CoV-2 Virus-Like Particle program are proceeding at Texas A&M University System labs. This is part of a Master Joint Development Agreement between iBio and TAMUS signed in 2016

iBio on March 18 reported progress towards developing vaccine candidates, including creation of the constructs and the filing on March 11 of four provisional U.S. patent applications supporting the VLP platform and other technologies for treating or preventing SARS-CoV-2 infections.

On February 3, iBio and Beijing CC-Pharming disclosed plans to develop and test a COVID-19 vaccine, combining the vaccine R&D experience—including work on the MERS-coronavirus—by CC-Pharming chairman and CSO Kevin Wang, PhD, and iBio VP Upstream Bioprocessing Sylvain Marcel, PhD, in rapid design of manufacturing processes for biopharmaceutical production in plant-based expression systems. If successful, the research will deliver product candidates for production at iBio's FastPharming Manufacturing Facility, built in 2010 with funding from the Defense Advanced Research Projects Agency (DARPA). The facility is equipped with automated hydroponics and vertical farming systems designed to produce biologics, using a relative of the tobacco plant.

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16. VBI Vaccines , National Research Council // CAMBRIDGE, Mass. & OTTAWA, Ontario—

March 31 (BUSINESS WIRE)--VBI Vaccines. (NASDAQ: VBIV) ("VBI"), a commercial-stage biopharmaceutical company developing next-generation infectious disease and immuno-oncology vaccines, today announced a collaboration with the National Research Council of Canada (NRC), Canada's largest federal research and development organization, to develop a pan-coronavirus vaccine candidate, targeting COVID-19, severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS).

Diaz-Mitoma, M.D., Ph.D., VBI's Chief Medical Officer: "Coronaviruses are enveloped viruses by nature, which we believe makes them a prime target for VBI's flexible enveloped virus-like particle (eVLP) platform technology, ongoing development of which is led and conducted at our research facility in Ottawa, Canada. Based on past clinical experience with the eVLP platform, we expect that a multivalent eVLP vaccine candidate, co-expressing SARS-CoV-2, SARS-CoV, and MERS-CoV spike proteins on the same particle, will be possible to develop. Moreover, we believe the trivalent construct could allow for the production of broadly reactive antibodies, which offer potential for protection from mutated strains of COVID-19 that may emerge over time."

The collaboration will combine VBI's viral vaccine expertise, eVLP technology platform, and coronavirus antigens with the NRC's uniquely-designed COVID-19 antigens and assay development capabilities to identify the most immunogenic vaccine candidate for further development. Under the

terms of the agreement, the NRC and VBI will collaborate to evaluate and select the optimal vaccine candidate. Following IND-enabling pre-clinical studies, conducted at both the NRC core facilities and at VBI's research facility in Ottawa, Canada, VBI believes that clinical study materials could be available in Q4 2020.

Peptide - Epitope – Protein subunit

17. Generex Biotechnology, Biology Institute of Shandong Academy of Sciences // Canada + Project in US + Chine

Treatment: Ii-Key peptide vaccine

Type: Vaccine based on Generex's Ii-Key immune system activation technology platform.

Generex on March 4 said it will use EpiVax's computational tools to predict epitopes that can be used to generate peptide vaccines against SARS-CoV-2 using Ii-Key technology. The companies reached agreement after EpiVax identified a number of hotspots in the amino acid sequences of SARS-CoV-2 proteins. in February 2020, Generex planned to evaluate the vaccine in clinical studies within 90 days.

Using epitopes predicted by EpiVax, Generex agreed to manufacture a series of synthetic amino acid peptides that mimic the epitopes of the virus and send them to Chinse researchers for testing in blood samples from patients who have recovered from COVID-19. The research team plans to select the best Ii-Key hybrid peptides to create a commercially viable vaccine that can proceed to human testing, Generex said

Generex said February 27 it has received a contract from the China Technology Exchange, Beijing Zhonghua Investment Fund Management Co. Ltd., Biology Institute of Shandong Academy of Sciences, and Sinotek-Advocates International Industry Development (Shenzhen) Co. Ltd. to develop a Ii-key vaccine. Generex said it would receive $1 million upfront to initiate project work in the U.S., a $5 million licensing fee for the Ii-Key technology, payment by the Chinese consortium for all costs and expenses related to the development of a COVID-19 vaccine, and a 20% royalty on each dose of vaccine produced.

18. Heat Biologics and Univ of Miami // Morrisville NC + Miami

Heat Biologics Announces Research Collaboration with University of Miami to Develop Vaccine Designed to Protect Against COVID-19 Coronavirus

March 05, 2020 Heat Biologics a clinical-stage biopharmaceutical company specialized in the development of therapeutic vaccines, announced today a strategic collaboration with the University of Miami Miller School of Medicine to support the development of a vaccine leveraging Heat's proprietary gp96 platform designed to target the SARS-CoV-2 coronavirus that causes COVID-19.

Clinical and preclinical studies suggest that Heat's gp96-based vaccines may be utilized to target COVID-19. Heat has treated more than 300 patients to date with its gp96-based therapeutic vaccines. Results from these studies together with positive outcomes in NIH and DOD-funded mouse and primate studies against SIV/HIV 1-2, malaria and zika, demonstrate that gp96 vaccines express a broad range of antigens and stimulate a robust systemic immune response, culminating in humoral and cell mediated responses in different organs including the gut, reproductive tract, liver and lungs.

Heat's COVID-19 vaccine will utilize Heat's gp96 platform to generate open docking sites for the insertion of multiple SARS-CoV-2 antigens. Heat anticipates that its novel approach should activate a potent immune response, without the disadvantages of possible genomic integration of foreign DNA or viral vector instability possible with attenuated viral vaccines. This approach is designed to induce a multi-epitope specific memory CD8 T-cell response that protects against multiple, distinct coronavirus strains across diverse human populations and against potential future mutations of SARS-CoV-2 and other coronavirus.

19. Novavax + Emergent Biosolutions // Maryland x2

Treatment: Vaccine candidate to be selected

April 10, 2020 - Novavax, a Maryland-based biotech company, said it would begin human trials in Australia in mid-May for its vaccine candidate. Novavax is one of more than two dozen companies that have announced promising vaccine programs that are speeding through the early stages of testing unlike ever before. When Chinese scientists posted the genetic sequence of the new coronavirus in January, researchers at Novavax started working on recombinant technology to make a synthetic version of the virus. Researchers used a baculovirus to carry bits of genetic material from the coronavirus into cells. By combining the recombinant vaccine with an adjuvant, or substance that increases immune stimulation, Novavax was able to achieve a high neutralization titer in preclinical tests — a measure of the protective antibodies that can block the virus. The company hopes to see a similar effect after giving more than 130 healthy adults two doses of the vaccine. Results of the trial, which will be conducted in Australia, are expected around July.

Vaccines designed to apply company's proprietary recombinant protein nanoparticle technology platform to generate antigens derived from the coronavirus spike (S) protein. Novavax said it expects to utilize its proprietary saponin-based Matrix-M™ adjuvant with COVID-19 vaccine candidates to enhance immune responses.

Novavax has agreed to use Emergent Biosolution's molecule-to-market contract development and manufacturing (CDMO) services to support clinical development of Novavax's COVID-19 vaccine candidate. Emergent said March 10 it agreed to produce the vaccine candidate and has initiated work, anticipating that the vaccine candidate will be used in a Phase I study within the next four months.

on March 10, Novavax announced $4M in funding from the Coalition for Epidemic Preparedness Innovations (CEPI) to support its efforts, and a collaboration with Emergent Biosolutions Inc. for contract development and manufacturing services

On February 26, Novavax cited progress in its development saying it has produced and is currently assessing multiple nanoparticle vaccine candidates in animal models prior to identifying an optimal candidate for human testing.

20. Cel-Sci, University of Georgia// Virginia

CEL-SCI to Develop LEAPS COVID-19 Immunotherapy in Collaboration with University of Georgia Center for Vaccines and Immunology. Treatment targeted for patients who are at highest risk of dying from COVID-19 due to tissue damage from infection to the lungs. studies show it reduced morbidity and mortality in mice with H1N1

21. Sanofi (FR : Sanofi Genzyme présent à Boston ainsi que Sanofi Pasteur)

Treatment: Unnamed vaccine

Type: Vaccine based on Sanofi's recombinant DNA platform, designed to produce an exact genetic match to proteins found on the surface of the virus. Sanofi said the DNA sequence encoding the antigen will be combined into the DNA of the baculovirus expression platform and used for rapidly producing large quantities of the coronavirus antigen, which will be formulated to stimulate the immune system to protect against the virus.

Apr 14, 2020 GSK and Sanofi Join Forces to Develop a COVID-19 Vaccine

GlaxoSmithKline and Sanofi have joined forces to develop an adjuvanted vaccine for COVID-19. The two companies are eying the second half of this year to begin clinical trials on their combined project and, if the vaccine meets expectations, the companies said it could be available for use in the second half of 2021. Terms of the collaboration have not yet been finalized, the companies said. Those terms, including financial, are expected to be completed sometime next week.

Under terms of the agreement that were announced, Sanofi will use its S-protein COVID-19 antigen, which is based on recombinant DNA technology to develop the vaccine candidate. The company's technology has produced an exact genetic match to proteins found on the surface of the virus, and the DNA sequence encoding this antigen has been combined into the DNA of the baculovirus expression platform, the company said. GSK will boost the antigen with its pandemic adjuvant technology. The use of an adjuvant is of particular importance in a pandemic situation since

it may reduce the amount of vaccine protein required per dose, allowing more vaccine doses to be produced and therefore contributing to protecting more people, GSK said.

The companies have set up a Joint Collaboration Task Force, co-chaired by David Loew, Global Head of Vaccines at Sanofi and Roger Connor, President of Global Vaccines at GSK.

In their announcement, both companies said they believe that global access to COVID-19 vaccines is a priority and both are committed to making any vaccine developed through the collaboration "affordable to the public and through mechanisms that offer fair access for people in all countries."

John Reed, MD, PhD, Sanofi's Global Head of Research and Development, restated March 16 that the Sanofi Pasteur vaccines global business unit plans to quickly develop a COVID-19 vaccine based on previous development work for a SARS vaccine, through a collaboration with the Biomedical Advanced Research and Development Authority (BARDA).

In non-clinical studies, the SARS vaccine candidate was immunogenic and afforded partial protection as assessed in animal challenge models, Sanofi said February 18. That earlier work by Protein Sciences, acquired by Sanofi in 2017, "provides a head start in expediting a COVID-19 vaccine," Sanofi stated.

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22. Baylor College of Medicine; New York Blood Center; Fudan University // Houston TX NY China

April 10, 2020 - And experimental vaccines developed by researchers at the University of Pittsburgh and Baylor College of Medicine in Houston are also waiting for permission from the Food and Drug Administration to begin testing in people.

Baylor has worked in the past on a vaccine comprised of a recombinant receptor-binding domain (RBD) of the SARS-CoV spike (S) protein

Back in 2010, researchers at Baylor College of Medicine and the University of Texas Medical Branch at Galveston developed a potential vaccine for SARS 1, which is another type of coronavirus. An outbreak of that virus in China between 2002 and 2003 killed more than 700 people.

The virus making headlines right now can also referred to as SARS 2. Dr. Maria Elena Bottazzi, the co-director of Baylor's Center for Vaccine Development, told Houston Matters with Craig Cohen on Thursday that SARS 1 and SARS 2 are genetically about 80 percent similar. And the SARS 1 vaccine has already gone through much of the testing processes needed for approval.

"We may be ahead of the curve," Bottazzi said.

But it's been sitting in a freezer for several years because researchers had trouble generating interest (and therefore funding) for clinical studies once the outbreak subsided, Dr. Peter Hotez told NBC News this week

23. EpiVax/Univ. of Georgia // US

EpiVax is collaborating with the university to find a vaccine for COVID-19, and has developed computational tools that identify the key regions of viral sequences that should be included in vaccines

24. Voltron Therapeutics, Vaccine & Immunotherapy Center at the Massachusetts General Hospital

Apr 02, 2020 - Voltron Therapeutics, Inc. Enters into Sponsored Research Agreement with The Vaccine & Immunotherapy Center at the Massachusetts General Hospital to Develop Potential COVID-19 Vaccine. The goal of the collaboration is to co-develop a new vaccine designed to protect patients at risk of novel coronavirus (COVID-19) infection, leveraging the Self-Assembling Vaccine (SAV) platform developed by the VIC and licensed exclusively to Voltron. HaloVax, a biopharmaceutical company and special purpose subsidiary of Voltron Therapeutics, Inc, will spearhead the development. The vaccine is expected to enter animal testing by the end of April 2020 and will be followed by safety studies as soon as possible thereafter.

The vaccine incorporates a heat shock protein that activates the immune system in contrast to prior vaccine efforts, which used chemical adjuvants like alum. The vaccine consists of a fusion protein between a heat shock protein and Avidin. Biotinylated immunogenic peptides are then incorporated to customize the vaccine.

25. SwiftScale Biologics //ITHACA, N.Y.

7-Apr-2020 - A biomanufacturing company spun out of Cornell research is seeking to rapidly translate an antibody therapy against COVID-19 by using cell-free biotechnology based on glycoengineered bacteria. And it could scale up the production 10 times faster than conventional methods. The company, SwiftScale Biologics, was co-founded by Matt DeLisa, the William L. Lewis Professor of Engineering in the Robert F. Smith School of Chemical and Biomolecular Engineering, and his longtime collaborator, Michael Jewett, a professor of chemical and biological engineering at Northwestern University.

The low-cost, rapid manufacture of therapeutic antibodies could be pivotal in combating the spread of COVID-19. The conventional means for manufacturing antibody drugs relies upon the use of mammalian cell lines, specifically Chinese hamster ovary (CHO) cells. Production can take nine months or more. “Bacteria cells do everything faster than CHO cells. They grow faster, they divide faster, they produce proteins faster,” DeLisa said. “The historical limitation has been that E. coli cells do not naturally produce any glycoproteins. What we’ve done in my lab is to equip E. coli with the machinery for installing complex carbohydrates onto proteins, which now opens up the opportunity to use these bacterial cells or their

lysates for making glycoprotein products such as monoclonal antibodies." SwiftScale's use of cell-free lysate derived from E. coli bacteria could shrink the timeline down to a month, which amid a pandemic could be "game changing," DeLisa said.

They have partnered with a biotherapeutics company, Centivax, that has identified several lead antibody candidates it believes could be used against the virus. Centivax is planning to begin a phase I/II clinical trial in late July, with SwiftScale ramping up its capabilities to produce 100,000 doses a month for 10 months if the trial is successful.

26. 7 Hills Pharma // Houston, TX

7 Hills Pharma launched a COVID-19 vaccine program for older adults. It is testing its lead compound 7HP349, a next-generation small-molecule integrin activator, as an oral adjuvant with a novel recombinant coronavirus vaccine. It hopes to enter the clinic in late 2020

27. Akers Biosciences and Premas Biotech // New Jersey + Inde

Apr 08, 2020 - Akers Biosciences, a developer of rapid health information technologies, today announced that its collaboration with Premas Biotech has successfully completed a second milestone, the successful expression of the three coronavirus antigens, Spike (S), Envelope (E), and Membrane (M), that were selected for their vaccine candidate. The antigens have been expressed using the D-CryptTM platform at Premas Biotech, which utilizes its vectors and S cerevisiae strain. Premas is now moving forward with purification and post-expression processing, which we believe should lead to a scaling up of the antigens.

Apr 7, 20202 - Akers Biosciences Announces $4.6 Million Registered Direct Offering Priced At-the-Market under Nasdaq Rules

March 27, 2020 - Akers Biosciences Acquires Licenses to Coronavirus Vaccine Candidate from Premas Biotech

28. WRAIR / USAMRIID

TBD

29. Janssen Pharmaceutical Cos. (Johnson & Johnson) + Beth Israel Deaconess Medical Center (BIDMC) // US Massachusetts

Type: vaccine type to be developed - Vaccine to be developed with BARDA

Separately, Janssen said February 11 it has expanded an existing collaboration with the Biomedical Advanced Research and Development Authority (BARDA) to develop a vaccine candidate for SARS-CoV-2. The partners agreed to share R&D costs and expertise to help accelerate Janssen's investigational COVID-19 vaccine into clinical trials. Janssen said it is also working closely with global partners to screen its library of antiviral molecules to accelerate discovery of potential COVID-19 treatments.

Status: Janssen Pharmaceuticals said March 13 that it and Beth Israel Deaconess have commenced preclinical testing of "multiple" vaccine prospects, with the goal of identifying a COVID-19 vaccine candidate for clinical trials by the end of March. Janssen expressed optimism that it can launch a Phase I clinical study of a potential vaccine candidate by year's end "in collaboration with multiple global strategic partners." Type: Vaccine based on Janssen's AdVac® and PER.C6® technologies. Janssen noted that research and preclinical collaboration with BIDMC's Center for Virology and Vaccine Research was foundational to developing vaccines for Zika and HIV. Janssen added that it is preparing to scale-up production and manufacturing capacities to levels required to meet global public health vaccination needs.

March 30, 2020 / Johnson & Johnson and BARDA Together Commit More than $1 Billion to Novel Coronavirus Vaccine Research and Development; ----------Company Expects to Initiate Phase 1 Human Clinical Studies of Vaccine Candidate at Latest by September 2020 - Johnson & Johnson Will Establish New U.S. ----------Vaccine Manufacturing Capabilities and Additional Production Capacity Outside the U.S. to Begin Production at Risk to Help Ensure Global Vaccine Supply. -- Johnson & Johnson (NYSE: JNJ) (the Company) today announced the selection of a lead COVID-19 vaccine candidate from constructs it has been working on since January 2020; the significant expansion of the existing partnership between the Janssen Pharmaceutical Companies of Johnson & Johnson and the Biomedical Advanced Research and Development Authority (BARDA); and the rapid scaling of the Company's manufacturing capacity with the goal of providing global supply of more than one billion doses of a vaccine.

Johnson & Johnson will scale up its manufacturing, committing more than $500 million to the project of developing a COVID-19 vaccine. J&J identified a lead vaccine candidate in late March, planning to start human testing by September. The vaccine could gain emergency clearance for use as soon as early 2021, when tens of millions of doses would be available. The company hopes to produce 1 billion doses by the end of 2021.
SCALE UP

Johnson & Johnson began efforts in January 2020, as soon as the novel coronavirus (COVID-19) sequence became available, to research potential vaccine candidates. Research teams at Janssen, in collaboration with Beth Israel Deaconess Medical Center, part of Harvard Medical School, constructed and tested multiple vaccine candidates using the Janssen AdVac® technology. Through collaborations with scientists at multiple academic institutions, the vaccine constructs were then tested to identify those with the most promise in producing an immune response in preclinical testing. Based on this work, Johnson & Johnson has identified a lead COVID-19 vaccine candidate (with two back-ups), which will progress into the first manufacturing steps.

The Company expects to initiate human clinical studies of its lead vaccine candidate at the latest by September 2020 and anticipates the first batches of a COVID-19 vaccine could be available for emergency use authorization in early 2021

They signed an agreement to work together on coronavirus on Jan. 31, Barouch said, just three weeks after Chinese scientists sequenced the genome of the virus and posted it online. Financial terms haven't been disclosed.

The company previously said that it had a plant in Leiden, Netherlands, prepared to manufacture 300 million doses a year in the first deployment of the vaccine. The firm didn't specify where it would make the other 700 million doses.

Barouch's lab and Janssen are using a common-cold virus to deliver a coronavirus antigen into cells to stimulate the immune system. Janssen has used the same approach to make 2 million doses of a vaccine for Ebola that has yet to be licensed but has been provided to about 40,000 people in Rwanda and the Democratic Republic of the Congo. Barouch's lab is already testing multiple versions of the coronavirus vaccine on mice, ferrets, and rhesus monkeys exposed to the pathogen at a research facility working under contract in the Washington, D.C., area, Barouch said.

Janssen and Beth Israel have designated one of the versions as the lead vaccine candidate for their collaboration and two others as backup candidates.

BARDA, which is helping to bankroll the effort, is part of the Department of Health and Human Services. The agency develops countermeasures against bioterrorism and other threats, including chemical, nuclear, and radiological attacks, as well as pandemics

30. Tonix Pharmaceuticals Holding // NY

Treatment: TNX-1800

Type: Live modified horsepox virus vaccine for percutaneous administration

Tonix said February 26 it has partnered with Southern Research to develop TNX-1800 as a vaccine treatment for COVID-19. TNX-1800 is under development as a potential smallpox preventing vaccine for the U.S. strategic national stockpile and as a monkeypox preventing vaccine.

31. Soligenix // New Jersey

Soligenix and University of Hawai'i at Mānoa Initiate Work on Novel Coronavirus Vaccine for COVID-19. Leverage existing research collaboration in Ebola and Marburg to assess potential coronavirus vaccines

32. Hoth Therapeutics // Cincinnati, OH

Hoth Therapeutics and Voltron Therapeutics have reached an agreement to form a joint venture, HaloVax. The joint venture will start preclinical studies for the development of potential vaccines to prevent COVID-19.

Hoth Therapeutics Announces Agreement to Joint Development of a Self-Assembling Vaccine (SAV) for the Potential Treatment of the Coronavirus (COVID-19). Hoth Therapeutics, Inc. (NASDAQ: HOTH), a biopharmaceutical company, today announced it has reached an agreement with Voltron Therapeutics, Hoth Therapeuticsto form a joint venture entity (to be named HaloVax) to commence preclinical studies for the development of vaccine prospects to prevent, intercept or treat the Coronavirus

33. University of Pittsburgh // Pittsburgh

The university's Center for Vaccine Research received samples of COVID-19 in February

34. University of Saskatchewan

The university's Vaccine and Infectious Disease Organization – International Vaccine Centre (VIDO-InterVac) has worked on different strains of coronavirus in the past, and is working to develop a vaccine for COVID-19

35. Dyadic International Inc.; The Israel Intitute for Biological Research // US, Jupiter, FL + Israel

C1 gene expression platform to express gene sequences and targets developed by IIBR into both an rVaccine candidate and monoclonal antibodies; expanded collaboration in February 2020

36. (US) UC Davis

Coronavirus Vaccine With Patch Delivery Technology Enters Preclinical Testing (30/04/2020)

https://patch.com/california/davis/uc-davis-coronavirus-vaccine-patch-delivery-technology-enters-preclinical-testing

Verndari Inc., a stage biopharmaceutical company, announced today that it will begin preclinical testing this week at UC Davis' Mouse Biology Program to evaluate a potential vaccine and delivery system for COVID-19. (Verndari's VaxiPatch is a single-dose vaccination kit that uses a dermal patch with a metal microneedle array to deliver vaccines.)

37. USC – San Diego

Participation d'une équipe de recherche de USC (University of Southern California) au développement d'un vaccin et des traitements contre COVID-19

Le 25 mars 2020, USC annonçait que les chercheurs du Viterbi Mork Family Department of Chemical Engineering and Materials Science ont rejoint l'effort mondial de recherche pour développer un vaccin contre le COVID-19. Pour créer le vaccin, le Professeur Pin Wang et son équipe ont mis au point un virus hybride, dont le noyau est basé sur celui du virus de la stomatite vésiculeuse (VSV), une famille de virus qui comprend entre autres la rage. La surface du virus hybride est ensuite recouverte de protéines Spike dérivées du virus COVID-19. Ce type de vaccin est connu sous le nom de vaccin vectorisé, et ne contient pas les composants nocifs des virus originaux. Celui-ci présente donc des avantages en termes de sécurité par rapport aux formes de vaccins utilisant des virus vivants atténués.

38. Sripps Research – San Diego

Jiang Zhu, Department of Integrative Structural and Computational Biology, a mis au point une technologie brevetée pour l'ingénierie de vaccins construits avec de minuscules fragments de nanoparticules de protéines, technique qui est actuellement étudiée par le laboratoire pour le COVID-19.