STAT[1]

An updated guide to the coronavirus drugs and vaccines in development

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March 19, 2020

Adobe

In the months since the novel coronavirus[4] rose from a regional crisis to a global threat, drug makers large and small have scrambled to advance their best ideas for thwarting a pandemic.

Some are taking a cue from older antivirals. Some are tapping tried-and-true technologies, and others are pressing forward with futuristic approaches to human medicine.

Here's a guide to some of the most talked-about efforts to treat or prevent coronavirus infection, with details on the science, history, and timeline for

each endeavor. We're looking at novel medicines, not repurposed drugs. (For more on some of the efforts to repurpose drugs, read this[5].) The below therapies and vaccines are sorted in order of how close they could be to approval, starting with a treatment in Phase 3 trials, followed by others in Phase 1 studies and then preclinical development. Approval, of course, would only come if they are proven safe and effective.

Gilead Sciences
Approach: Treatment
Stage: Phase 3

Gilead's remdesivir is being studied in five clinical trials around the world. In China, Gilead is recruiting about 1,000 patients diagnosed with the coronavirus to determine whether multiple doses of remdesivir can reverse the infection. The primary goals are reducing fever and helping patients get out of the hospital within two weeks. The drug, which previously failed in a study on Ebola virus, is administered intravenously. More on the drug here[7].

Ascletis Pharma
Approach: Treatment
Stage: Phase 1

Chinese drug maker Ascletis Pharma is testing a combination of antivirals, one approved for HIV and one approved for hepatitis C, that might treat coronavirus infection. Last month, the company enrolled 11 patients with coronavirus-caused pneumonia and administered a cocktail of danoprevir and ritonavir. All 11 were eventually discharged, according to Ascletis[8]. The company hasn't disclosed plans for a larger study.

Moderna Therapeutics
Approach: Vaccine
Stage: Phase 1

Moderna set a drug industry record with mRNA-1273, a vaccine candidate identified just 42 days after the novel coronavirus was sequenced. The company is working with the National Institutes of Health on a healthy-volunteer study that began earlier this month. If mRNA-1273 proves itself to be safe, Moderna will enroll hundreds more patients to determine whether the vaccine protects against infection. Moderna's product is a synthetic strand of messenger RNA, or mRNA, designed to convince bodily cells to produce antibodies against the virus. The company, founded in 2010, is yet to win Food and Drug Administration approval for any of its mRNA medicines. More on the vaccine candidate here[9].

CanSino Biologics
Approach: Vaccine
Stage: Phase 1

CanSino Biologics, headquartered in Tianjin, is close to testing its novel coronavirus vaccine in a clinical trial in China. CanSino's approach involves taking a snippet of coronavirus' genetic code and entwining it with a harmless virus, thereby exposing healthy volunteers to the novel infection and spurring the production of antibodies. The company said this week[10] that Chinese authorities approved its planned trial, which will begin as soon as possible. CanSino markets a vaccine for Ebola virus in China.

Arcturus Therapeutics
Approach: Vaccine
Stage: Preclinical

Arcturus Therapeutics is pressing forward with a vaccine that relies on engineering RNA. The company plans to take an RNA virus that has been edited to encode for proteins that will protect against infection and load it into a liquid nanoparticle. The resulting vaccine, being developed in partnership with Duke University, promises a better immune response at a lower dose than competing mRNA approaches, according to the company. The vaccine remains in preclinical development, and Arcturus has promised to start a human trial as quickly as possible.

BioNTech
Approach: Vaccine
Stage: Preclinical

Germany's BioNTech is working on an mRNA vaccine for the novel coronavirus with plans to enter clinical testing in April. Like its competitors, the company uses strands of mRNA to spur the production of protective antibodies. Earlier this month, Shanghai's Fosun Pharma signed a deal[13] to market BioNTech's vaccine in China if it's eventually approved. Pfizer has agreed[14] to co-develop the vaccine in the rest of the world.

CureVac
Approach: Vaccine
Stage: Preclinical

Like Moderna, CureVac uses man-made mRNA to spur the production of proteins. And, like Moderna, it got a grant from the nonprofit Coalition for Epidemic Preparedness Innovations to apply its technology to coronavirus. CureVac has said it expects to have a candidate ready for animal testing by April, aiming to start a clinical study this summer. The company is also working with CEPI on a mobile mRNA manufacturing technology, one that would theoretically allow health care workers to rapidly produce vaccines to respond at the site of an outbreak.

Eli Lilly
Approach: Treatment
Stage: Preclinical

Eli Lilly has partnered with a Canadian firm called AbCellera to develop antibody treatments for coronavirus infection. Using a blood sample from a coronavirus survivor, AbCellera identified more than 500 antibodies that might protect against the virus. Now it's working with Lilly[15] to identify which are most potent. The two companies aim to have a treatment ready for human trials within the next four months.

GlaxoSmithKline
Approach: Vaccine

Stage: Preclinical

GlaxoSmithKline, one of the world's largest vaccine manufacturers, is lending its technology to a Chinese biotech firm at work on a coronavirus vaccine. Under an agreement signed last month[16], GSK is providing its proprietary adjuvants — compounds that enhance the effectiveness of vaccines — to Clover Biopharmaceuticals, a privately held company based in Chengdu. Clover's approach involves injecting proteins that spur an immune response, thereby priming the body to resist infection. GSK struck a similar deal with the University of Queensland in Australia, which is also working on a protein vaccine.The company has not said when it expects to advance either into human testing. GSK is also lending its scientific expertise to CEPI.

Inovio Pharmaceuticals
Approach: Vaccine
Stage: Preclinical

Inovio has spent the last four decades working to turn DNA into medicine, and the company believes its technology could quickly generate a vaccine for the novel coronavirus. Working with CEPI grant money, Inovio has come up with a DNA vaccine it believes can generate protective antibodies and keep patients from infection. The company has partnered with a Chinese manufacturer, Beijing Advaccine Biotechnology, and is working through preclinical development with a candidate called INO-4800. The company expects to progress into clinical trials in April and has promised to manufacture 1 million doses of its candidate this year.

Johnson & Johnson
Approach: Vaccine and treatment
Stage: Preclinical

Johnson & Johnson, which has in the past responded to outbreaks of the Ebola and Zika viruses, is taking a multipronged approach to the coronavirus. The company is in the early days of developing a vaccine that would introduce patients to a deactivated version of the virus, triggering an immune response without causing infection. Human trials could begin by November. At the same time, J&J is working with the federal Biomedical Advanced Research

and Development Authority on potential treatments for patients who are already infected, a process that includes investigating whether any of its older medicines might work against the coronavirus.

Trending Now: [17]

A fiasco in the making? As the coronavirus pandemic takes hold, we are making decisions without reliable data [18]

Pfizer
Approach: Vaccine and treatment
Stage: Preclinical

Outside of its vaccine work with BioNTech, Pfizer has put out a five-point plan[19] to address the outbreak, which includes making its technology, scientists, expertise, and manufacturing available to outside institutions. The company has also promised to create a rapid-response program to make it easier to respond to future pandemics.

Regeneron Pharmaceuticals
Approach: Treatment
Stage: Preclinical

Regeneron has grown into a $50 billion business based on its ability to craft human antibodies out of genetically engineered mice. Now it's tapping that technology in hopes of treating coronavirus. The company immunized its proprietary antibody-generating mice with a harmless analog of the novel coronavirus, generating potential treatments for the infection. Regeneron plans to select the two most potent antibodies and advance the cocktail into human studies by early summer. The last time Regeneron embarked on this process, during the Ebola outbreak of 2015, it came up with an antibody cocktail that roughly doubled survival rates for treated patients. More on Regeneron's treatment here[20].

Sanofi
Approach: Vaccine and treatment

Stage: Preclinical

Sanofi, which has successfully developed vaccines for yellow fever and diphtheria, is working with BARDA on an answer to the coronavirus. Sanofi's approach involves taking some of the coronavirus's RNA and mixing it with genetic material from a harmless virus, creating a chimera that can prime the immune system without making patients sick. Sanofi expects to have a vaccine candidate to test in the lab within six months and could be ready to test a vaccine in people within a year to 18 months. Approval would likely be at least three years away, the company said. Outside of vaccines, Sanofi and Regeneron have started a clinical trial to test whether Kevzara, an approved anti-inflammatory drug, can help with the symptoms of Covid-19.

Takeda
Approach: Treatment
Stage: Preclinical

Japanese pharma giant Takeda is at work on a treatment derived from the blood of people who have already been infected by the coronavirus. The company is drawing blood from coronavirus survivors, harvesting the plasma, and then isolating the protective antibodies that kept those patients alive. It's not a new idea. Blood transfusions have been used to combat viral outbreaks since at least the Spanish Flu pandemic of 1918. But Takeda's take on it could prove to be faster in development than other therapeutic approaches. According to the company, the therapy could be available to patients in 12 to 18 months.

Vir Biotechnology
Approach: Treatment
Stage: Preclinical

Vir Biotechnology, a company focused on infectious disease, has isolated antibodies from people who survived SARS, a viral relative of the novel coronavirus, and is working to determine whether they might treat the infection. Teaming up with Chinese pharma contractor WuXi Biologics, the San Francisco-based Vir is in the early stages of development and hasn't specified when it expects to have products ready for human testing. The

company has also aligned with Alnylam Pharmaceuticals to work on treatments that might halt viral replication by interfering with RNA signaling. Vir's CEO, Biogen veteran George Scangos, is also coordinating the trade group BIO's response to the coronavirus outbreak.

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