COVID-19 Vaccines Update
Published May 29, 2020

- There is high anticipation for a safe and effective vaccine for COVID-19, which is critical for the world to resume many elements of pre-pandemic civilization. The optimistic estimate is that the United States may have a vaccine by the end of 2020; others have said it is more likely to be the end of 2021 or even 2022.
- At this rate, the COVID-19 vaccine will be the fastest ever developed in vaccine history. It took more than two decades for a successful polio vaccine. In this case, speed may be a trade-off for safety. However, the ultimate goal for any vaccine is to prevent people from getting sick when exposed to the virus.

Current Vaccine Candidates

At the time of publication, there are more than 125 vaccine candidates in clinical trials for COVID-19. Of these, 10 are currently in human clinical trials (5 in China; 4 in the United States; 1 in Europe), as summarized in the following table. Many of these candidates are using a vaccine platform that was originally intended for other disease targets.

<table>
<thead>
<tr>
<th>Vaccine/Developer</th>
<th>Platform</th>
<th>Other Target Candidates</th>
<th>Notes</th>
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<tbody>
<tr>
<td>ChAdOx1-S (AZD1222) University of Oxford (Europe)</td>
<td>Non-replicating viral vector</td>
<td>MERS, Influenza, TB, Chikungunya, Zika, MenB, Plague</td>
<td>• Phase 2b/3 • April 30: AstraZeneca and University of Oxford announced agreement for global development and distribution • May 24: Oxford executive said vaccine has about a 50% chance of working</td>
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<tr>
<td>Ad5-nCoV CanSino Biologics/Beijing Institute of Biotechnology (China)</td>
<td>Non-replicating viral vector</td>
<td>Ebola</td>
<td>• Phase 2 • May 22: Lancet reported Ad5 vectored vaccine is tolerable and immunogenic at 28 days post-vaccination in healthy adults, and rapid specific T-cell responses were noted from day 14 post-vaccination</td>
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<tr>
<td>mRNA-1273 Moderna/NIAID (US)</td>
<td>LNP-encapsulated mRNA</td>
<td>Multiple candidates</td>
<td>• Phase 2 (IND submitted) • May 18: Moderna press release stated vaccine was “generally safe and well tolerated” in 8 human participants • Phase 3 study to begin in July and expected to last around 6 months • NIAID Dir, Dr. Anthony Fauci said it was “good news” but was “cautiously optimistic”</td>
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## COVID-19 Vaccines in Human Trials as of May 29, 2020 (cont.)

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| NVX-CoV2373 Novavax (US) | Full length recombinant SARS-COV-2 glycoprotein nanoparticle vaccine adjuvanted with Matrix M | RSV, CCHF, HPV, VZV, Ebola | • Phase 1/2  
• Human study recently began |
| Name TBD Wuhan Institute of Biological Products/Sinopharm (China) | Inactivated | | • Phase 1/2  
• 96 patients (3 age cohorts) completed Phase 1 trial  
• Moved into Phase 2 in April, no other info yet |
| Name TBD Beijing Institute of Biological Products/Sinopharm (China) | Inactivated | | • Phase 1/2 |
| PiCoVacc Sinovac (China) | Inactivated + alum-adjuvant | SARS | • Phase 1/2  
• Effective in 8 different rhesus macaque monkeys – produced complete antibody protection, no virus detected  
• No information on human data yet but first group of volunteers enrolled in April: ²/³ will get active vaccine and ¹/³ will receive placebo |
| BNT162 BioNTech/Fosun Pharma/Pfizer (US) | 3 LNP-mRNAs | | • Phase 1/2  
• No results reported yet  
• No timetable for Phase 3 trial |
| INO-4800 Inovio (US) | DNA plasmid vaccine with electroporation | Multiple candidates | • Phase 1  
• Positive results in mice and guinea pigs on immunogenicity with robust antibody response, but no human data yet  
• Human testing began in April; expect a readout in June  
• No safety signals in the human dosing |
| Name TBD Institute of Medical Biology, Chinese Academy of Medical Sciences (China) | Inactivated | | • Phase 1 |