CUSEF EXPLAINER

GLOBAL DEVELOPMENT OF COVID-19 VACCINES

CHINA-UNITED STATES EXCHANGE FOUNDATION

PHOTO: CATH NEWS NEWZEALANDP

A global debate has evolved around the development of a vaccine to combat the pandemic caused by COVID-19, with countries racing to become the first to deploy an effective treatment for their populations. Here are some of the latest developments.

KEY POINTS

- **Countries around the world are competing fiercely** to develop Covid-19 vaccines.
- **Companies in at least 20 countries** have been conducting **clinical trials** of the vaccines.
- **China and the U.S. are the apparent leaders** in the race.
- Despite the competitions, companies from different countries are **cooperating with each other** to create Covid-19 vaccines.

IN THIS ISSUE

By Wendy Weng, Research Director | Contact: wendy.weng@cusef.org.hk

Process of Vaccine Development in General

Identifyng and Understanding the virus

- Identify the virus
- Figure out how the virus affects human
- Decipher the genome of the virus

Creating vaccine candidates

- Manufacture a vaccine based on the above findings

Testing

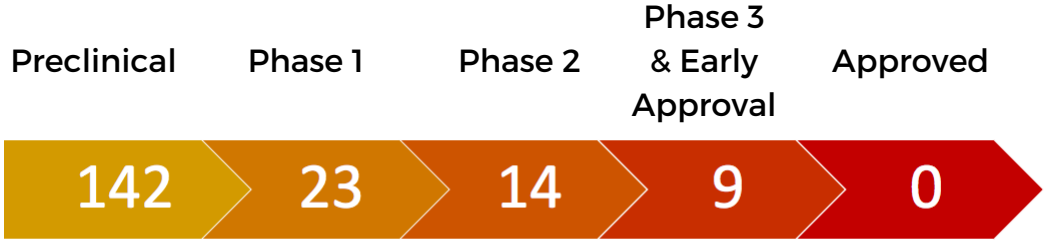
- **Preclinical testing**: The vaccine is applied to **animals** to prove its effectiveness to prevent the disease.
- **Phase 1 clinical trials**: The vaccine is given to **a few dozen of healthy young adults**—usually 20-100 people—to test the safety and immune response on human, as well as the dosage.
- **Phase 2 clinical trials**: The testing is carried out on **hundreds of people** from different demographic groups, allowing scientists to see if the results differ among these people.
- **Phase 3 clinical trials**: **Thousands of people** take the vaccine and are exposed to an environment that could cause infection so that to prove the efficacy of the vaccine. Usually, it **takes years** to complete the phase 3 clinical trials.

Government Approvals

- Regulators in a country approve safe and effective vaccines after reviewing the trail results.
- In the case of emergency, some countries would grant certain vaccines approvals for limited use before getting the adequate results of phase 3 trials. This is risky, but once successful, the benefit of taking such early actions could be huge.

Progress of Covid-19 Vaccine Development

As of September 3, there are at least 36 vaccines in clinical trials and 141 in preclinical evaluation around the world. Some institutes combine the adjacent phases to speed up the process.



* Including eight vaccines in phase 1/2, two in phase 2/3, and three gained early approvals

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Types of Covid-19 Vaccines under Development

1. Whole-Virus Vaccines: weakened or inactivated coronavirus

Inactivated virus

- Pros: safe, easy to make, high stability
- Cons: requiring large dose, short duration of immunity

Weakened virus

- Pros: Long duration of immunity, suitable for mass production
- Cons: Lower safty, low stability, long development time

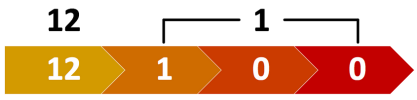
2. Protein-Based Vaccines: protein or protein fragment of coronavirus

Protein Subunit

- Pros: Safe, stable, suitable for mass production
- Cons: Difficult to manufacture, adjuvants and multiple doses required

Virus-like particles (VLP)

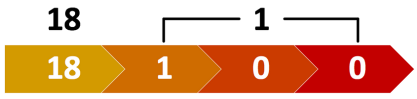
- Pros: Safe, stable, high efficacy, suitable for mass production
- Cons: Difficult to manufacture



3. Viral Vector Vaccines: virus containing coronavirus' genes

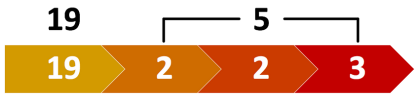
Replicating Viral

- Pros: Safe, high efficacy, few side-effects
- Cons: the effectiveness could be blunted by existing immunity



Non-Replicating Viral

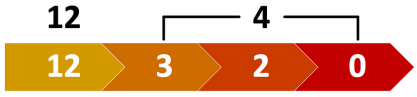
- Pros: Safe, high efficacy, few side-effects
- Cons: booster shots required



4. Genetic Vaccines: coronavirus' genes

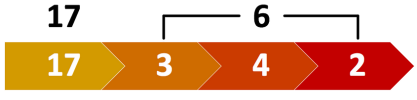
DNA

- Pros: Easy to manufacture, inexpensive, good thermostability
- Cons: Low efficacy, potential safety problem

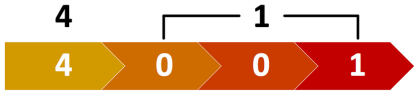


RNA

- Pros: Safe, easy to manufacture
- Cons: Low stability, efficacy unclear yet, difficult to engineer



4. Others: Live Attenuated Virus, Replicating Bacteria Vector, and Repurposed Vaccines



Sources: WHO, Nature, Chinese Journal of Preventive Medicine, Economic Daily, Shanghai Security, Sinolink Security

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Covid-19 Vaccine Frontrunners

- So far, there are **nine vaccine candidates** that have **entered phase 3 clinical trials**.
- Except for the repurposed vaccine by the Murdoch Children's Research, the other eight are either **RNA**, **inactivated**, or **non-replicating viral vector** vaccines.
- **Five of these leading candidates involve parties from China** and **the U.S. parties are with two of them**.
- Other bodies participated in the nine vaccines are from **Russia**, **the U.K.**, **Germany**, **Sweden**, and **Australia**.

Companies leading the coronavirus vaccine development

CanSino Biologics Inc./Beijing Institute of Biotechnology

- Vaccine platform: Non-replicating viral vector
- Number of doses: 1
- Clinical Stage: Phase 3, approved for limited use

Gamaleya Research Institute

- Vaccine platform: Non-replicating viral vector
- Number of doses: 2 (timing: 0, 21 days)
- Clinical Stage: Phase 3, approved for limited use

University of Oxford/AstraZeneca

- Vaccine platform: Non-replicating viral vector
- Number of doses: 1
- Clinical Stage: Phase 2 and 3 combined (1st supply est.: mid-Sepember)

Sinovac

- Vaccine platform: Inactivated
- Number of doses: 2 (timing: 0, 14 days)
- Clinical Stage: Phase 3, approved for limited use

Wuhan Institute of Biological Products/Sinopharm

- Vaccine platform: Inactivated
- Number of doses: 2 (timing: 0, 14 days or 0, 21 days)
- Clinical Stage: Phase 3

Beijing Institute of Biological Products/Sinopharm

- Vaccine platform: Inactivated
- Number of doses: 2 (timing: 0, 14 days or 0, 21 days)
- Clinical Stage: Phase 3

Moderna/NIAID

- Vaccine platform: RNA
- Number of doses: 2 (timing: 0, 28 days)
- Clinical Stage: Phase 3 (1st supply est.: end of Sepember)

BioNTech/Fosun Pharma/Pfizer

- Vaccine platform: RNA
- Number of doses: 2 (timing: 0, 28 days)
- Clinical Stage: Phase 2 and 3 combined (1st supply est.: early October)

Sources: WHO, New York Times, BiopharmaDive, CUSEF

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Race to the Finishing Line

China and the U.S. are apparent leaders of the vaccine development

- Most of the companies that are conducting clinical trials for Covid-19 vaccines are from China and the U.S.
  - **Chinese companies and institutes** are working on **12** of the 36 vaccine candidates.
  - **The U.S. government and companies** are involving in **13** of them.
- The countries have been **generous with the vaccine funding**. The U.S. government has already granted $955 million to Moderna while institutes in China have gained the full support from the government.

Companies and governments across the world are actively involving in the vaccine development

- According to CUSEF's count, companies or government bodies from **at least 20 countries** are having **clinical trials of Covid-19 vaccines**.
- **172 economies** have been in discussions on their **potential participation in COVAX**, a global collaboration help provide equitable access to the vaccines, tests, and treatments to Covid-19.
- Except for the frontrunner countries, countries such as **India, Korea, Israel, and Canada are also actively participating** in the vaccine development.

Competition is fierce

- **Being the first to get the safe and effective vaccine translates to a bonanza** which will create huge bargain power for the government and good income for the company that develops the vaccine, and, therefore, have significant political and industrial implications.
- Even without winning the first place, **countries that have their own vaccines will be less reliant on vaccine imports** and become more resilient to the pandemic.

Institutes from different countries are cooperating

- Despite the rivalry, cooperation between parties from different countries are seen in many cases of Covid-19 vaccines development. For example:
  - China's Medigen Vaccine Biologics Corporation is working with the U.S. National Institutes of Health and the American company Dynavax on a protein subunit vaccine;
  - Italy's ReiThera, Germany's LEUKOCARE, and Belgian's Univercells are jointly developing a viral vector vaccine.

Changes won't happen immediately after the vaccines are produced

- **Supply chains** have to be built up. It also needs time to gain **public acceptance**. On top of this, real changes will only happen when the benefit is **shared globally**.

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Comments on Vaccine and International Relations

Implications of making the first available vaccine

Lawrence Gostin

Professor of global health law at Georgetown University Law Center

The vaccine is partly about health, but it's absolutely equally as much about getting our engine of productivity back. If China had it and we didn't, their economy could hum, and ours would continue to be in social distancing lockdowns and disruptions. This has economic, political and public health consequences. *(2020-06-04)*

Bonnie Glaser

Director of the China Power Project at the Center for Strategic and International Studies

Within China, the issue of the vaccine has taken on a symbol of whether China is going to be the leading power in the world. *(2020-06-04)*

Countries should avoid nationalism and share their research results

Lawrence Gostin

Assistant professor of medicine at Dartmouth's Geisel School of Medicine

The danger of vaccine nationalism is that it undercuts efforts to end this pandemic in the shortest period of time. Once we have a vaccine, we will want to prioritize individuals who are most likely to transmit the virus, regardless of nationality or ability to pay. *(2020-06-04)*

J. Stephen Morrison

Director of the global health policy program at the Center for Strategic and International Studies

This is a planetary problem, and it requires a planetary solution. We have to be conscious and realistic about the nationalistic impulses that move through this. How do you get that collaborative finish to all of this that's not going to leave whole segments of the world at the side of the road? *(2020-06-04)*

Skepticism about China's willingness to share its vaccines

Larry Gostin

Professor of Global Health Law at Georgetown University

I'm not sure the Chinese would give it to us. There are plenty of buyers outside the U.S. So that's a big risk for the United States. *(2020-08-31)*

China is not seeking No. 1 in the vaccine R&D

Ai Jun

Writer of Global Times

China has no intention to fight the US to become the No.1 in COVID-19 vaccine R&D. Chinese scientists are working around the clock, but they are not rushing to win the holy grail of being the first. They emphasize safety and effectiveness. But the US does not believe so. It is keen to keep its overwhelming advantage in most sectors in the world. It overlooked the fact that quite a few countries are attractive without being the No.1 in any specific area. *(2020-09-02)*

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About CUSEF

The China-United States Exchange Foundation is an independent, non-profit and non-governmental foundation committed to the belief that a positive and peaceful relationship between the strongest developed nation and the most populous, fast-developing nation is essential for global wellbeing. Founded in Hong Kong in 2008 and privately funded, CUSEF builds platforms to encourage constructive dialogue and diverse exchanges between the people of the U.S. and China.

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