THE RACE TO STOP COVID-19

As a new strain of coronavirus threatens public health systems across the globe, researchers are racing to develop a vaccine.

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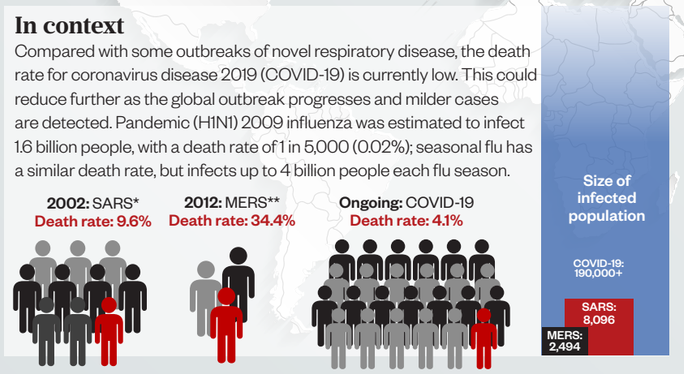
In context

Compared with some outbreaks of novel respiratory disease, the death rate for coronavirus disease 2019 (COVID-19) is currently low. This could reduce further as the global outbreak progresses and milder cases are detected. Pandemic (H1N1) 2009 influenza was estimated to infect 1.6 billion people, with a death rate of 1 in 5,000 (0.02%); seasonal flu has a similar death rate, but infects up to 4 billion people each flu season.

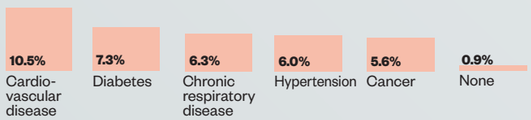


*Severe acute respiratory syndrome ** Middle East respiratory syndrome

Case fatality rates for COVID-19

By age:

By comorbid condition:



By gender:
Males **2.8%**
Females **1.7%**

Symptoms and transmission

- Common symptoms*: **fever** (98.6%); **weakness** (69.6%); **cough** (59.4%); **muscle pains** (34.8%); **difficulties breathing** (31.2%);
- Less common symptoms*: **diarrhoea** (10.1%); **nausea and vomiting** (10.1%); **dizziness** (9.4%); **headaches** (6.5%); **stomach pain** (2.2%);
- Incubation period: 0–14 days;
- Severity: data from 44,000 cases of COVID-19 in China suggest that 80.9% of cases are mild, 13.8% are severe and 4.7% are critical. Severe cases are more prevalent in older people and those with an existing long-term condition, such as cardiovascular disease, diabetes, respiratory disease or hypertension;
- Transmission: person-to-person spread between close contacts (up to 1.8 metres) through respiratory droplets;
- Diagnosis: COVID-19 is suspected based on clinical symptoms. Cases are only confirmed when there is a positive laboratory test;
- Treatment: treatment of COVID-19 is symptomatic, such as providing oxygen. Medicines specifically licensed for COVID-19 are not currently available, but clinical trials of several antiviral drugs are being conducted in China.

*Percentages are taken from a case series of 138 consecutive hospitalised patients in China.

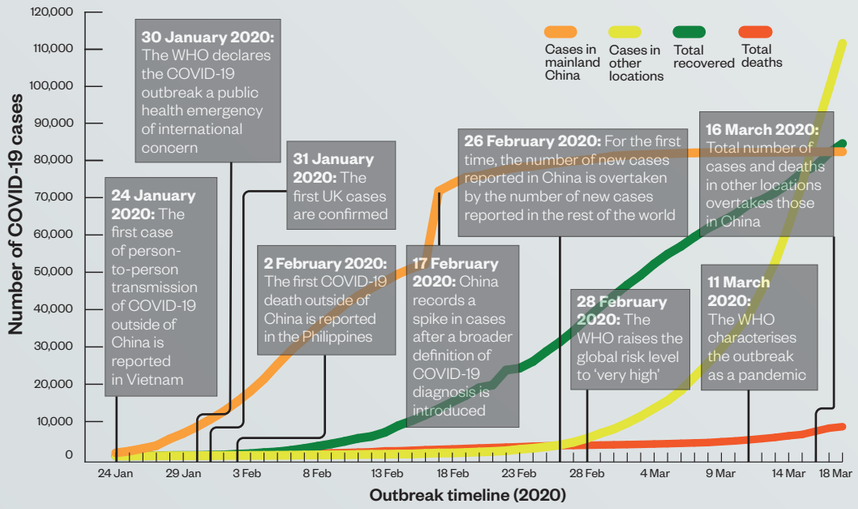
Global takeover

31 December 2019: The first cases of pneumonia with unknown cause in Wuhan, China, are reported to the World Health Organization (WHO)

7 January 2020: The Chinese authorities identify the novel coronavirus and temporarily name it '2019-nCoV', which is later changed to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

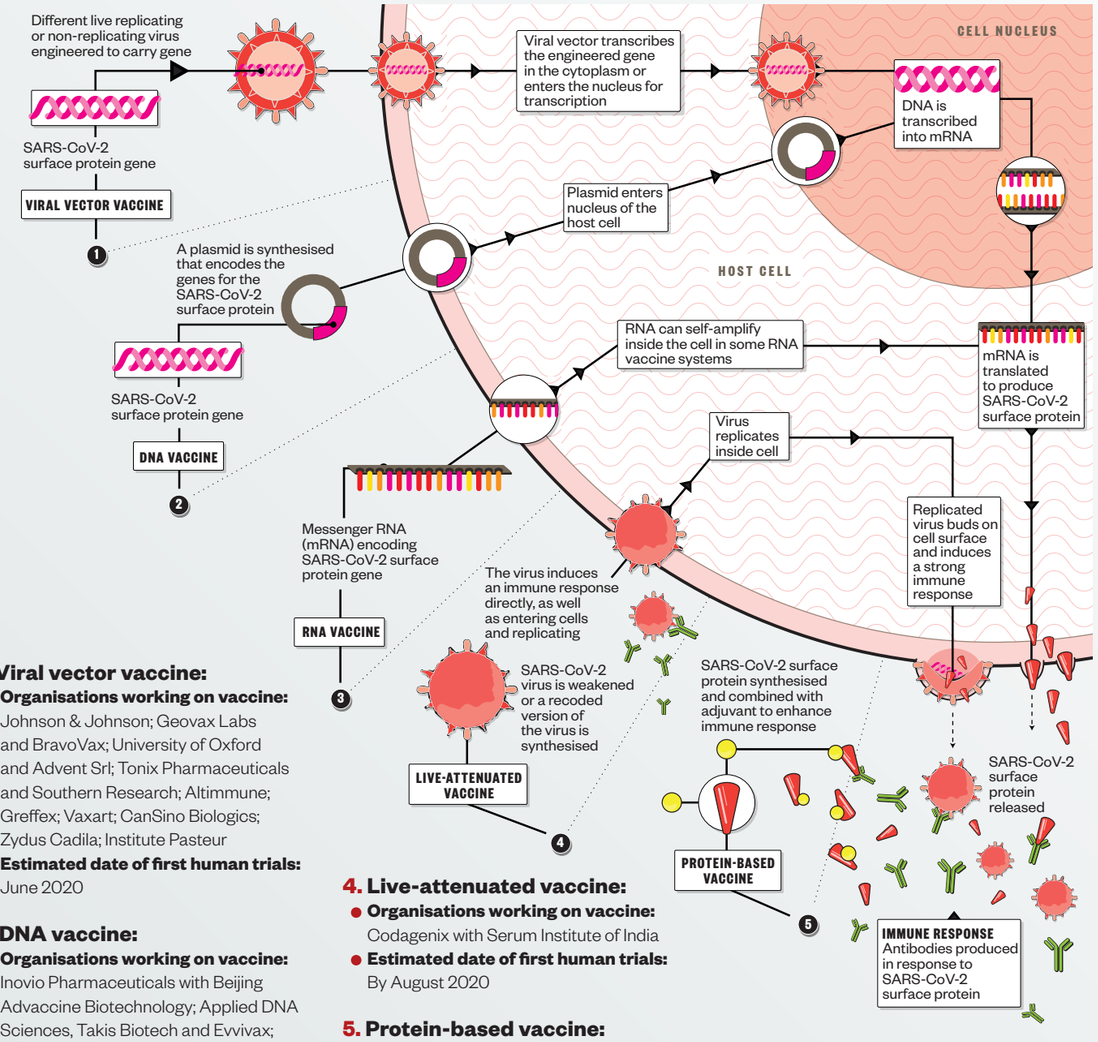
10 January 2020: The Chinese Center for Disease Control and Prevention makes the genome of SARS-CoV-2 available

11 January 2020: The first COVID-19 death is reported in China



Vaccine development

There are five main approaches being taken to develop a vaccine against SARS-CoV-2, with several biotechnology companies, academic organisations and pharmaceutical companies employing different technologies in the race to bring their vaccine candidate to clinical trials. The World Health Organization (WHO) hopes that a vaccine will be available by October 2021.



1. Viral vector vaccine:

- **Organisations working on vaccine:** Johnson & Johnson; Geovax Labs and BravoVax; University of Oxford and Advent Srl; Tonix Pharmaceuticals and Southern Research; Altimmune; Greffex; Vaxart; CanSino Biologics; Zydus Cadila; Institute Pasteur
- **Estimated date of first human trials:** June 2020

2. DNA vaccine:

- **Organisations working on vaccine:** Inovio Pharmaceuticals with Beijing Advaccine Biotechnology; Applied DNA Sciences, Takis Biotech and Evvivax; Zydus Cadila
- **Estimated date of first human trials:** April 2020

3. RNA vaccine:

- **Organisations working on vaccine:** CureVac; Moderna and US National Institute of Allergy and Infectious Diseases; Stermirna Therapeutics, Tongji University and Chinese Center for Disease Control and Prevention; Imperial College London; Arcturus and Duke-NUS Medical School, Singapore; BioNTech and Pfizer
- **Date of first human trials:** March 2020

4. Live-attenuated vaccine:

- **Organisations working on vaccine:** Codagenix with Serum Institute of India
- **Estimated date of first human trials:** By August 2020

5. Protein-based vaccine:

- **Organisations working on vaccine:** Novavax; Clover Biopharmaceuticals with GSK; Baylor College of Medicine, University of Texas Medical Branch, New York Blood Center and Fundan University, China; University of Saskatchewan, Canada; University of Queensland, Australia, GSK and Dynavax; Vaxart; Generex; ExpreS2ion; Vaxil Bio; Sanofi Pasteur; iBio/CC-Pharming: Generex and EpiVax; Walter Reed Army Institute of Research and United States Army Medical Research Institute of Infectious Diseases; EpiVax and University of Georgia
- **Estimated date of first human trials:** By June 2020

Immune response:

- It is not known how strong the immune response needs to be to protect against SARS-CoV-2; therefore, some of the vaccines being developed may not work.
- Before candidates reach clinical trials, investigators must also ensure they induce protective immunity, not immunopathology, as was seen in early attempts to develop a SARS-CoV vaccine after it emerged in 2002.

SOURCES: *China CDC Weekly* 2020;2(8):113-122; Department of Health and Social Care; *JAMA* 2020, doi: 10.1001/jama.2020.1585; *JAMA* 2020, doi: 10.1001/jama.2020.2648; John Hopkins Center for Systems Science and Engineering; *Lancet* 2012;12(9):687–695; World Health Organization
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All data correct as of 19 March 2020