

Coronaviruses

WHAT ARE CORONAVIRUSES?

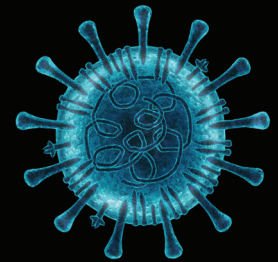
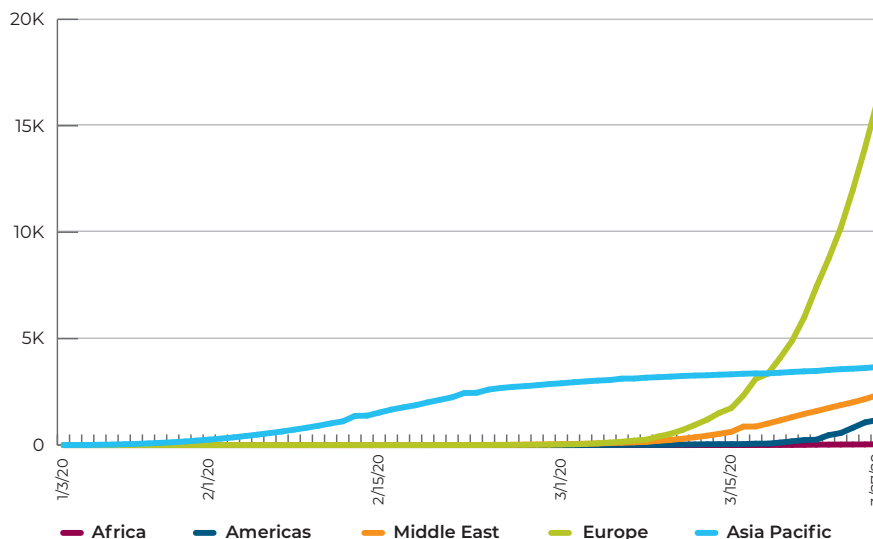
Discovered in the 1960s, coronaviruses (CoV) are a large group of RNA viruses in the family Coronaviridae that cause disease in humans and animal species. Human illness includes respiratory infections that range from the common cold to viral (direct) or bacterial (indirect) pneumonia and are especially serious in infants and at-risk adults.

There are seven known coronavirus types/strains. Continual circulation through the human population occurs with the common human strains: HCoV-229E, HCoV-NL63, HCoV-OC43 and HCoV-HKU1. More severe respiratory conditions are caused by severe acute respiratory syndrome (SARS)-CoV, Middle East respiratory syndrome (MERS)-CoV and 2019 novel coronavirus (COVID-19). SARS-CoV and COVID-19 share 70% genetic similarity.

SYMPTOMS, COMPLICATIONS AND FATALITY RATES

The common human coronaviruses usually cause mild to moderate upper respiratory tract complications. Symptoms include cough, sore throat, runny nose, fever, headache and fatigue. With the more serious coronaviruses, many cases progress to pneumonia resulting in a high case fatality rate. Similar to MERS-CoV, COVID-19 symptoms include fever, cough and shortness of breath. A recent study estimated the median incubation period of COVID-19 is 5.1 days, and 97.5% of those who develop symptoms will do so within 11.5 days of infection.¹

Total Number of COVID-19-related Deaths



Fatality rates

SARS-CoV: 10%

MERS-CoV: 35%

COVID-19: 0.6-7.2%*

* Based on currently available data from the WHO and CDC

Coronavirus outbreaks

2002: SARS-CoV in China

2012: MERS-CoV in Saudi Arabia

2019: COVID-19, which originated in China and is now a pandemic

Data current as of March 28, 2020

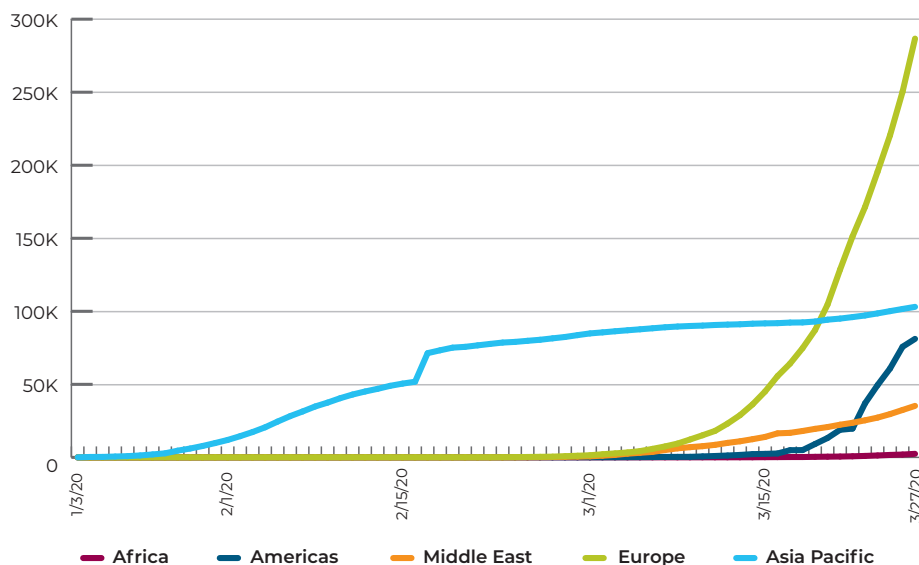
TRANSMISSION

Coronaviruses can be transmitted to humans from animal reservoirs (e.g., camels, bats) leading to rapid human-to-human transmission through close contact that includes touching and respiratory droplets.^{2,3} Initial sequences from COVID-19 in China match recent sequences in US patients, suggesting a common animal origin. Disease spread can also happen by touching the surfaces of contaminated objects, but fecal contamination is rare. Because it is highly contagious, COVID-19 transmission is efficient. As a result, the virus is rapidly spreading—from a single city in China to 175 countries in approximately 3 months. Due to the large-scale spread of COVID-19, the World Health Organization is urging all countries not yet affected to prepare for the potential arrival of COVID-19 by readying emergency response systems; increasing capacity to detect and care for patients; ensuring hospitals have the space, supplies and necessary personnel; and developing life-saving medical interventions.

DIAGNOSIS AND TREATMENT

Diagnosis of CoV infections occurs through laboratory testing of respiratory specimens and serum via RT-PCR at public health laboratories. For COVID-19, the WHO quickly adopted a test developed in Germany, published technical guidelines on January 17 and worked with private companies to produce testing kits. In the US, to date, 19 emergency use authorizations have been issued by the FDA for diagnostic tests.

Total Number of Confirmed COVID-19 Cases



Some of the organizations working on vaccines or treatments for COVID-19

- AbbVie
- AIM ImmunoTech
- Altimune
- APEIRON Biologics
- Ascleitis Pharma
- Bayer
- Beijing Advaccine Biotechnology
- Beijing CC-Pharming Ltd
- Beijing Staidson Biopharma
- Biocryst Pharma
- BioXyTran
- Celularity
- Chugai Pharmaceutical
- Clover Biopharmaceuticals
- CSL
- CureVac
- CytoDyn
- Fujifilm Holdings
- Genexx Biotechnology
- Gilead Sciences
- GlaxoSmithKline
- iBio, Inc.
- ImmunoPrecise Antibodies
- InflaRx
- Innovation Pharmaceuticals
- Inovio Pharmaceuticals
- Johnson & Johnson
- LineaRX
- Mannin Research
- Moderna Therapeutics
- NanoViricides
- Novavax
- Pharmstandard
- Q Biomed
- Regeneron Pharmaceuticals
- Sanofi
- Sorrento Therapeutics
- Takis Biotech
- Tonix Pharmaceuticals Holdings
- University of Queensland
- University of Oxford
- Vaxart
- Vir Biotechnology
- WuXi Biologics
- Zhejiang Hisun Pharmaceutical Company

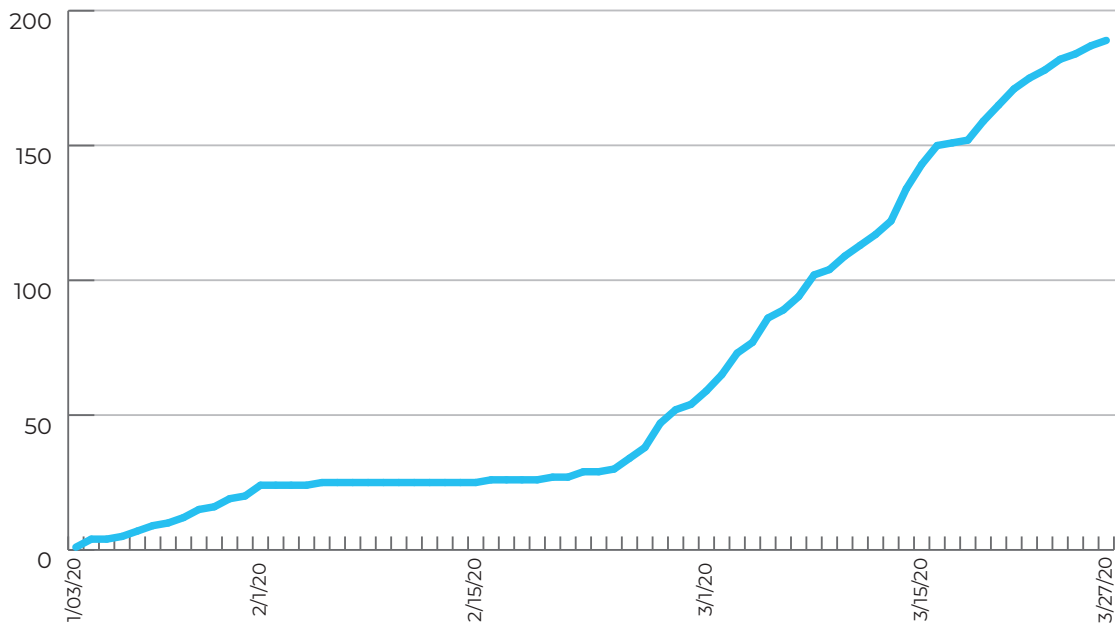
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For all CoV, there are no approved vaccines, and there are no specific treatments for SARS and MERS. Instead, treatment typically includes supportive care for symptom relief such as antibiotics to treat the pneumonia-causing bacteria, antiviral medicines and high doses of steroids to reduce swelling in the lungs.

There are more 130 studies for investigational therapies for COVID-19 registered in clinicaltrials.gov. Existing drugs investigated for potential efficacy in COVID-19 include lopinavir/ritonavir (HIV), rintatolimod (chronic fatigue syndrome), recombinant human angiotensin-converting enzyme 2 (rhACE2; acute lung injury, acute respiratory distress syndrome and pulmonary arterial hypertension), danoprevir plus ritonavir (HIV), ASC09 and ritonavir (HIV), ASC09 and oseltamivir (HIV), ritonavir and oseltamivir (HIV), chloroquine phosphate (malaria), favipiravir (influenza, Ebola), remdesivir (Ebola), darunavir and cobicistat (HIV), umifenovir (influenza), REGN3048 and REGN3051 (in testing already for MERS-CoV), and placental-derived natural killer (NK) cell therapy (in testing already for cancers).

The WHO also recently announced a large global trial, SOLIDARITY, focusing on what it considers the four most promising drugs: remdesivir; chloroquine and hydroxychloroquine, used to treat malaria; lopinavir and ritonavir, used to treat HIV; and this same combination plus interferon-beta.

Total Number of Countries/Territories Affected by COVID-19



Data current as of March 28, 2020

CURRENT SITUATION, EPIDEMIOLOGY AND WHAT'S NEXT

SARS-CoV has not been detected since 2004, while MERS-CoV continues to circulate in camels. Only eight weeks into the COVID-19 outbreak, the virus and genetic sequence were identified, and PCR and serological assay were available for use. The World Health Organization considered that unprecedented for a new disease. Since COVID-19 was declared a Public Health Emergency of International Concern on January 30, 2020 and a pandemic on March 11, 2020, health authorities across the world have monitored its progression and implemented combative measures, while biopharma has worked to rapidly develop vaccines/treatments. Many countries have banned travel and put in regional or country-wide isolation policies to prevent transmission.



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1 Lauer SA, et al. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. *Ann Int Med*, 2020

2 Fehr, A. & Perlman, S., *Methods Mol Biol*, 1282, 2015, pp. 1-23

3 Alsolamy, S. & Arabi, Y. *Can J Respir Ther*, 51(4), 2015, pp. 102

Data current as of March 28, 2020