Overview of COVID-19 and the Research Response

Anthony S. Fauci, M.D.
Director
National Institute of Allergy and Infectious Diseases
National Institutes of Health
June 11, 2020
**Science**  
January 3, 2020

**Novel Human Virus? Pneumonia Cases Linked to Seafood Market in China Stir Concern**

By Dennis Normile

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**The Washington Post**  
January 9, 2020

**Washington Post: China Identifies New Strain of Coronavirus as Source of Pneumonia Outbreak**

Health officials run thermal scans on passengers arriving from Wuhan, China, at Bangkok’s Suvarnabhumi Airport on Wednesday.

By Gerry Shih and Lena H. Sun
Coronavirus Disease 2019 (COVID-19) (December 2019 – Present)

COVID-19 is caused by the novel coronavirus SARS-CoV-2
January 17, 2020
Travelers at 3 U.S. Airports to Be Screened for New, Potentially Deadly Chinese Virus

January 21, 2020
U.S. Screenings for the Coronavirus Expanded to Airports in Atlanta and Chicago
First Travel-related Case of 2019 Novel Coronavirus Detected in United States
The Centers for Disease Control and Prevention (CDC) has confirmed an infection with the virus that causes COVID-19 in California in a person who reportedly did not have relevant travel history or exposure to another known patient with COVID-19.
March 3: President Trump Visits NIH Vaccine Research Center
COVID-19 Globally: 6.9 Million Cases
213 Countries and Territories

United States: 1.3 million+

Sources: NY Times; Worldometer. Data as of 6/6/2020, 11:00am
New York to Shut Down As It Becomes Next Virus Hot Spot
Reported COVID-19 Cases and Deaths the United States

Reported cases: 1,971,399
Reported deaths: 111,491

Sources: Washington Post, Worldometer. Data as of 6/6/2020, 11:00 am
Reported COVID-19 Cases and Deaths in the United States

Reported cases per day

- March 1 to June 6
- 7-day average
- 0 to 30,000 cases per day

Reported deaths per day

- March 1 to June 6
- 7-day average
- 0 to 2,000 deaths per day

Graphics: Washington Post. Data as of 6/6/2020, 11:00 am
## COVID-19 Clinical Presentation

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>83-99%</td>
</tr>
<tr>
<td>Cough</td>
<td>59-82%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>44-70%</td>
</tr>
<tr>
<td>Anorexia</td>
<td>40-84%</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>31-40%</td>
</tr>
<tr>
<td>Myalgias</td>
<td>11-35%</td>
</tr>
</tbody>
</table>

**Other non-specific symptoms reported**

- Sore throat, nasal congestion, headache, diarrhea, nausea, vomiting. Loss of smell/taste preceding the onset of respiratory symptoms.

Source: WHO, 5/2020
<table>
<thead>
<tr>
<th>COVID-19: Wide Spectrum of Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asymptomatic Illness</strong></td>
</tr>
<tr>
<td><strong>Mild Illness</strong></td>
</tr>
<tr>
<td><strong>Moderate Disease</strong></td>
</tr>
<tr>
<td><strong>Severe Pneumonia</strong></td>
</tr>
<tr>
<td><strong>Critical Illness</strong></td>
</tr>
</tbody>
</table>

Sources: CDC, WHO
Prevalence of Asymptomatic SARS-CoV-2 Infection
A Narrative Review

DP Oran and EJ Topol

- Data from 16 cohorts, total n = 45,000+
- Asymptomatic persons account for 40-45% of SARS-CoV-2 infections
Groups at Higher Risk for Severe COVID-19 Illness

- Age >65 years
- People in nursing homes or long-term care facilities
- Asthma
- Chronic kidney disease
- Chronic lung disease
- Diabetes
- Hemoglobin disorders
- Immunocompromised
- Liver disease
- Serious heart disease
- Obesity (BMI >40)

Source: CDC
"The most pervasive disparities are observed among African American and Latino individuals, and where data exist, American Indian, Alaska Native, and Pacific Islander populations."
COVID-19 Research Response
## NIH COVID-19 Supplemental Funding

($) in millions and are available until 9/30/2024

<table>
<thead>
<tr>
<th>Institute</th>
<th>Description</th>
<th>Amount (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NIAID</strong></td>
<td>Basic research, pathogenesis, animal models, epidemiology, diagnostics, vaccines, therapeutics</td>
<td>$1,532</td>
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<tr>
<td><strong>Other Institutes</strong></td>
<td></td>
<td>$2,055</td>
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<tr>
<td><strong>NHLBI</strong></td>
<td>Therapeutics and longitudinal studies</td>
<td>103</td>
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<tr>
<td><strong>NIEHS</strong></td>
<td>Worker safety</td>
<td>10</td>
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<tr>
<td><strong>NIBIB</strong></td>
<td>Point-of-care and other rapid testing</td>
<td>560</td>
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<tr>
<td><strong>NLM</strong></td>
<td>Research resources</td>
<td>10</td>
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<tr>
<td><strong>NCATS</strong></td>
<td>Drug screening</td>
<td>36</td>
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<tr>
<td><strong>NIH-OD</strong></td>
<td>Point-of-care and other rapid testing</td>
<td>1,030</td>
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<tr>
<td><strong>NCI</strong></td>
<td>Serological testing and associated technologies</td>
<td>306</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>$3,587</td>
</tr>
</tbody>
</table>
- Improve fundamental knowledge of SARS-CoV-2 and COVID-19 disease
- Develop diagnostics and assays
- Characterize and test therapeutics
- Develop safe and effective vaccines
Viral Isolates and Reagents Made Available to the Research Community
Cryo-EM Structure of the 2019-nCoV Spike in the Prefusion of Conformation

D Wrapp, N Wang, KS Corbett, JA Goldsmith, C-L Hsieh, O Abiona, BS Graham, JS McLellan

Atomic-level structure of SARS-CoV-2 spike protein. Receptor binding domain is colored green and circled.
Human ACE2 is the receptor for SARS-CoV-2
Respiratory Disease in Rhesus Macaques Inoculated with SARS-CoV-2

Rhesus macaque model recapitulates moderate disease observed in the majority of human COVID-19 cases
NIH Begins Study to Quantify Undetected Cases of Coronavirus Infection

Serological study will provide insights into which communities and populations are most affected by COVID-19
Study to Determine Incidence of Novel Coronavirus Infection in U.S. Children Begins

■ HEROS study aims to enroll 6,000 people/2,000 families
■ Study goals are to determine
  – The incidence of SARS-CoV-2 in children
  – Whether asthma or allergies affect the incidence of infection
  – The percentage of infected children who develop COVID-19
NIAID STRATEGIC PLAN FOR COVID-19 RESEARCH
APRIL 10, 2020

- Improve fundamental knowledge of SARS-CoV-2 and COVID-19 disease
- Develop diagnostics and assays
- Characterize and test therapeutics
- Develop safe and effective vaccines
News Release

Coronavirus (COVID-19) Update: FDA Publicly Shares Antibody Test Performance Data From Kits as Part of Validation Study

- Validation study is headed by NCI, with collaboration of NIAID, CDC and BARDA
- Includes tests already available as well as those not yet on the mark
NIH Mobilizes National Innovation Initiative for COVID-19 Diagnostics

- NIH Rapid Acceleration of Diagnostics (RADx) Initiative for COVID-19
- Award up to $500 million to support development of COVID-19 diagnostics
- Improve fundamental knowledge of SARS-CoV-2 and COVID-19 disease
- Develop diagnostics and assays
- Characterize and test therapeutics
- Develop safe and effective vaccines
Investigational Therapeutics for COVID-19

- Remdesivir
- Other broad-spectrum antivirals
- Convalescent plasma/hyperimmune immunoglobulin
- Repurposed drugs, e.g. hydroxychloroquine, lopinavir/ritonavir
- Host modifiers/immune-based therapies
- Anti-SARS-CoV-2 monoclonal antibodies
- Others
Remdesivir for the Treatment of Covid-19 — Preliminary Report

JH Beigel, HC Lane et al. for the ACTT-1 Study Group Members

- Patients who received remdesivir had a 32% faster time to recovery than those who received placebo (p<0.001)
- Results also suggested a survival benefit
- N=1,063 patients from 10 countries in U.S., Europe, Asia
NIH Clinical Trial Testing Antiviral Remdesivir Plus Anti-Inflammatory Drug Baricitinib for COVID-19 Begins

“ACTT-2 will examine if adding an anti-inflammatory agent to the remdesivir regimen can provide additional benefit for patients, including improving mortality outcomes.”

-Anthony S. Fauci, MD
Expert U.S. Panel Develops NIH Treatment Guidelines for COVID-19

"Living document" expected to be updated often as new clinical data accrue

Covid19treatmentguidelines.nih.gov
- Improve fundamental knowledge of SARS-CoV-2 and COVID-19 disease
- Develop diagnostics and assays
- Characterize and test therapeutics
- Develop safe and effective vaccines
BARDA-Supported COVID-19 Vaccine Candidates

- mRNA
- Replication Incompetent Adenovirus (ChAdOx1)
- Replication Incompetent Adenovirus (Ad26)
- Adjuvanted protein subunit
- Replication-competent Vesicular Stomatitis Vector (VSV)
mRNA Vaccine Approach

mRNA for spike protein of coronavirus

Inject into muscle cells

Muscle cells read the mRNA and make spike protein
NIH Clinical Trial of Investigational Vaccine for COVID-19 Begins

Study Enrolling Seattle-Based Healthy Adult Volunteers

- Trial of vaccine candidate mRNA-1273 will enroll 45 healthy adult volunteers ages 18 to 55 years over approximately 6 weeks.
Moderna Coronavirus Vaccine Trial Shows Promising Early Results

Data from 8 healthy volunteers: vaccine safe and provoked a strong immune response. It is on an accelerated timetable to begin larger human trials soon.
Trump Administration Announces Framework and Leadership for 'Operation Warp Speed'

- National program to accelerate development, manufacturing, and distribution of COVID-19 vaccines, therapeutics, and diagnostics
- Public-private partnership between HHS (CDC, FDA, NIH, BARDA), DoD, other federal agencies, and private firms
- Chief Scientific Advisor: Moncef Slaoui, PhD
- Chief Operating Officer: General Gustave F. Perna
Unprecedented collaboration and resources will be required to research and develop safe and effective vaccines for COVID-19 that can be manufactured and delivered in the scale of billions of doses to people globally.
April 17: NIH Launches Public-Private Partnership to Speed COVID-19 Vaccine and Treatment Options

The Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV) partnership will:

- Standardize and share preclinical evaluation methods in an open forum
- Prioritize and accelerate clinical evaluation of therapeutic candidates with near-term potential
- Maximize clinical trial capacity and effectiveness
- Advance vaccine development
Briefing President Trump on the COVID-19 (Coronavirus) Outbreak
May 5: White House Briefing of Vice President Pence on COVID-19 Vaccines
January 29: White House Coronavirus Task Force Announced

Chair: VP Mike Pence
Response Coordinator: Deborah Birx

- Jerome Adams
- Alex Azar
- Stephen Biegun
- Robert Blair
- Ben Carson
- Francis Collins
- Ken Cuccinelli
- Kelvin Droegemeier
- Thomas Engels
- Anthony Fauci
- Joe Grogan
- Stephen Hahn
- Derek Kan
- Larry Kudlow
- Chris Liddell
- Steven Mnuchin
- Robert O'Brien
- Sonny Perdue
- Matthew Pottinger
- Robert Redfield
- Gene Scalia
- Joel Szabat
- Seema Verma
- Robert Wilkie