COVID-19: Public Health and Scientific Challenges

Anthony S. Fauci, M.D.
Director
National Institute of Allergy and Infectious Diseases
National Institutes of Health

Coronavirus Phylogenetic Tree

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Severe Human Coronavirus Disease: Past as Prologue

Severe Acute Respiratory Syndrome (SARS) (2002-2003)

Middle East Respiratory Syndrome (MERS) (2012-present)

Science

The Washington Post

Novel Human Virus? Pneumonia Cases Linked to Seafood Market in China Stir Concern
By Dennis Normile

China Identifies New Strain of Coronavirus as Source of Pneumonia Outbreak
Coronavirus Phylogenetic Tree

Coronavirus Disease 2019 (COVID-19)

COVID-19 is the name of the disease caused by the novel coronavirus SARS-CoV-2

COVID-19 Globally: 27.4 Million Cases in 215 Countries and Territories

COVID-19 in the United States

New COVID-19 Cases: US vs. EU

SARS-CoV-2 Virology

- Beta-CoV: same subgenus as SARS CoV-1 and some bat CoVs
- RNA virus: enveloped, positive-sense, single-stranded
- Large genome: ~30,000 Kb
- 4 structural proteins: S, E, M, N
  - S allows virus to attach to and fuse with cell membrane
- ACE2 receptor: cell receptor
Transmission

SARS-CoV-2 Transmission
- Transmission between people in close contact
- Transmission via particles that remain in the air over time and distance
- Infected surfaces
- Virus found in stool, blood, semen and ocular secretions; role in transmission unknown
- Animals (including domesticated) not major source of human infection

Clinical Manifestations

COVID-19 Clinical Presentation
- Fever 83–99%
- Cough 59–82
- Fatigue 44–70
- Anorexia 40–84
- Shortness of breath 31–40
- Myalgia 11–35
Other non-specific symptoms reported
- Sore throat, nasal congestion, headache, diarrhea, nausea, vomiting. Loss of smell/taste preceding the onset of respiratory symptoms.
COVID-19: Wide Spectrum of Disease

- Asymptomatic Illness: No symptoms
- Mild Illness: Uncomplicated upper respiratory tract infection
- Moderate Disease: Pneumonia without the need for supplemental oxygen
- Severe Pneumonia: Pneumonia plus one of the following: respiratory rate > 30 breaths/min; severe respiratory distress; or SpO2 < 90% on room air
- Critical Illness: ARDS, sepsis, septic shock, multiple organ dysfunction/failure

Spectrum of Disease Among 44,672 Individuals with Confirmed COVID-19, China

- Mild/Mod: 81%
- Severe: 14%
- Critical: 5%

Case-fatality rate: 2.3%

Manifestations of Severe COVID-19 Disease

- Acute respiratory distress syndrome (ARDS)
- Hyperinflammation
- Acute cardiac injury, arrhythmias, cardiomyopathy
- Acute kidney injury
- Neurological disorders
- Hypercoagulability leading to thromboembolic complications, including pulmonary embolism and acute stroke
- Multisystem inflammatory syndrome in children (MIS-C)

COVID “Long-Haulers”

People at Increased Risk for Severe COVID-19 Illness

- Older adults
- People of any age with certain underlying medical conditions

People at Increased Risk for Severe COVID-19 Illness

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Cumulative Rates of Laboratory-Confirmed COVID-19-Associated Hospitalizations by Age, United States, March 1 – August 29, 2020

People at Increased Risk for Severe COVID-19 Illness
- Older adults
- People of any age with certain underlying medical conditions

Underlying Medical Conditions Strongly Associated with Increased Risk for Severe COVID-19 Illness
- Serious heart conditions (e.g., heart failure, coronary artery disease, cardiomyopathies)
- Chronic kidney disease
- Chronic obstructive pulmonary disease (COPD)
- Diabetes, type 2
- Obesity (BMI ≥ 30)
- Cancer
- Sickle cell disease
- Immunocompromised state from solid organ transplant

Underlying Medical Conditions That May Confer Increased Risk for Severe COVID-19 Illness
- Asthma
- Other chronic lung diseases
- Cerebrovascular disease
- Diabetes, type 1
- Hypertension
- Immunosuppressed state from bone marrow transplant, immune deficiencies, HIV, use of corticosteroids or other immunosuppressive medications

Underlying Medical Conditions That May Confer Increased Risk for Severe COVID-19 Illness
- Inherited metabolic disorders
- Neurologic conditions
- Liver disease
- Pregnancy
- Smoking
- Thalassemia

COVID-19 in Persons Living with HIV – What Do We Know Today
- Analysis of 8 studies in Europe and U.S. show similar rates of SARS-CoV-2 in persons with HIV vs. general population
- HIV does not increase risk for SARS-CoV-2 infection, COVID-19 disease course or outcomes
- Comorbidities major driver of severe COVID-19 in persons with/without HIV coinfection
COVID-19 and Racial/Ethnic Disparities

“The most pervasive disparities are observed among African American and Latino individuals, and where data exist, American Indian, Alaska Native, and Pacific Islander populations.”

Nationwide, Black People are Dying at 2.4 Times the Rate of White People

We have lost at least 36,785 Black lives to COVID-19. Black people account for 21% of COVID-19 deaths where race is known.

The Potential Important Role of Rapid, Inexpensive Screening Tests for SARS-CoV-2

Diagnostics
Prevention

COVID-19 Prevention: Personal Preventive Measures

- Diligent hand washing
- Avoiding close contact
  - Avoiding crowds/mass gatherings
  - Physical distancing, >6 feet
- Covering mouth and nose with mask/cloth face cover
- Covering sneezes/coughs
- Avoiding face-touching
- Regular cleaning/disinfecting of frequently touched objects

COVID-19 Prevention: Public Health Measures

- Social/physical distancing orders
- Stay-at-home orders
- School, venue, and nonessential business closure
- Bans on public gatherings
- Travel restriction with exit and/or entry screening
- Aggressive case identification and isolation
- Contact tracing and quarantine

Therapeutics

Therapeutics for COVID-19

Recommended by the NIH COVID-19 Treatment Guidelines Panel for Certain Patients

- Remdesivir (investigational antiviral)
- Dexamethasone (corticosteroid)

Examples of Other Investigational Therapies

- Antivirals
- Blood-derived products, e.g., convalescent plasma, hyperimmune globulin
- Monoclonal antibodies against SARS-CoV-2
- Immunomodulators, e.g., cytokine inhibitors, interferons
- Adjunct therapies, e.g., anticoagulants

News Release

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
Remdesivir for the Treatment of COVID-19 — Preliminary Report
JH Beigel, HC Lano 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

Effect of Dexamethasone in Hospitalized Patients with COVID-19: Preliminary Report
The RECOVERY Collaborative Group
- RECOVERY trial in UK — 6,425 patients randomized to receive dexamethasone 6 mg once per day (oral or IV) for up to ten days or usual care alone
- Dexamethasone reduced 28-day mortality by 36% in ventilated patients and by 18% in other patients receiving oxygen
- No benefit for patients not receiving respiratory support

Vaccines

Selected COVID-19 Vaccine Candidates

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