COVID-19: An Update for the Research Community

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Disclosures

• Research Support°
  o AiCuris, Janssen, Shire

• Paid Consultation
  o Adagio, AlloVir, Celltrion, Cidara, Genentech/Roche, Janssen, Shionogi, Viracor Eurofins

• Unpaid Consultation
  o Romark

• Data & Safety Monitoring Board Participation
  o NIH, Janssen, Merck, SAB Biotherapeutics, Sequiris, Takeda, Vitaeris

As of 10/19/20; ° Paid to Northwestern University.
COVID-19 Update

• Epidemiology

• Prevention
  o Masking and social distancing
  o Vaccines

• Treatment Options

• What to Expect from the Flu Season
COVID-19: Current Global Situation

- Latin America now accounts for 31 per cent of average global deaths.
- The US share of average global daily deaths has fallen to 13 per cent.

Total excess deaths per million people:

- Ecuador (Sep 16)
- Spain (Sep 15)
- UK (Sep 11)
- Belgium (Aug 30)
- Italy (Jun 30)
- US (Aug 22)
- Portugal (Sep 22)
- Netherlands (Sep 16)
- Chile (Sep 16)
- S Africa (Sep 15)
- Sweden (Sep 8)
- France (Sep 6)
- Switzerland (Sep 13)
- Israel (Sep 16)
- Austria (Sep 13)
- Germany (Aug 23)
- Iceland (Aug 9)
- Denmark (Aug 12)
- Norway (Aug 30)

Daily deaths of patients diagnosed with coronavirus (7-day rolling average):

- Mar 15 - Oct 14: 422 average daily deaths
- Mar 15 - Oct 14: 6,798 peak deaths

Daily confirmed deaths (11 by region, 7-day rolling average):

- N America
- Europe
- Latin America
- Africa
- Asia

https://www.ft.com/content/a26fbf7e-48f8-11ea-aeb3-955839e06441 - Accessed 21 October 2020
COVID-19: Current Situation in the United States

How the number of new cases has changed in the last two weeks.

[Map showing the spread of COVID-19 cases across the United States with a 7-day average line and data for cases and deaths as of Oct 20, 2020.]

TOTAL REPORTED | ON OCT. 20 | 14-DAY CHANGE
Cases 8.3 million+ | 60,598 | +36%
Deaths 220,987 | 929 | +7%

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>IgG Positive % (95% CI)</th>
<th>Total (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Category</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- N</td>
<td>316</td>
<td>6510</td>
</tr>
<tr>
<td>- 18-29</td>
<td>97 (7.4%, 6.1 - 9%)</td>
<td>1304</td>
</tr>
<tr>
<td>- 30-39</td>
<td>97 (4.4%, 3.6 - 5.3%)</td>
<td>2208</td>
</tr>
<tr>
<td>- 40-49</td>
<td>60 (4.4%, 3.4 - 5.6%)</td>
<td>1368</td>
</tr>
<tr>
<td>- 50-59</td>
<td>47 (4.5%, 3.3 - 6%)</td>
<td>1042</td>
</tr>
<tr>
<td>- 60+</td>
<td>15 (2.6%, 1.4 - 4.2%)</td>
<td>588</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- N</td>
<td>316</td>
<td>6510</td>
</tr>
<tr>
<td>- Female&lt;sup&gt;a&lt;/sup&gt;</td>
<td>256 (4.9%, 4.4 - 5.6%)</td>
<td>5180</td>
</tr>
<tr>
<td>- Male</td>
<td>60 (4.5%, 3.5 - 5.8%)</td>
<td>1330</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- N</td>
<td>316</td>
<td>6510</td>
</tr>
<tr>
<td>- Asian</td>
<td>29 (4.6%, 3.1 - 6.5%)</td>
<td>634</td>
</tr>
<tr>
<td>- Hispanic/Latino</td>
<td>46 (9.6%, 7.1 - 12.7%)</td>
<td>477</td>
</tr>
<tr>
<td>- Non-hispanic Black</td>
<td>17 (8.5%, 5 - 13.2%)</td>
<td>201</td>
</tr>
<tr>
<td>- Non-hispanic White</td>
<td>212 (4.3%, 3.8 - 5%)</td>
<td>4877</td>
</tr>
<tr>
<td>- Other/Multiracial/NA&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12 (3.7%, 1.9 - 6.4%)</td>
<td>321</td>
</tr>
</tbody>
</table>

Seropositivity of NM Employees: **Seroprevalence Rate 4.8%**
Seropositivity by Neighborhood: **NM HCW vs. IDPH Data**

COVID-19: Illinois Situation

Race: Death

<table>
<thead>
<tr>
<th>Race</th>
<th>Death Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>2176</td>
</tr>
<tr>
<td>White</td>
<td>3862</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1672</td>
</tr>
</tbody>
</table>

Race: Diagnosis

<table>
<thead>
<tr>
<th>Race</th>
<th>Diagnosis Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>73,129</td>
</tr>
<tr>
<td>Hispanic</td>
<td>68,982</td>
</tr>
<tr>
<td>Asian</td>
<td>6010</td>
</tr>
<tr>
<td>AI/AN**</td>
<td>334</td>
</tr>
<tr>
<td>NH/PI*</td>
<td>483</td>
</tr>
<tr>
<td>Other</td>
<td>5905</td>
</tr>
<tr>
<td>Left Blank</td>
<td>64,383</td>
</tr>
<tr>
<td>Black</td>
<td>37,083</td>
</tr>
</tbody>
</table>
COVID-19: Special Populations - Minorities

Coronavirus cases per 10,000 people, by age and race

Source: Centers for Disease Control and Prevention | Note: Data is through May 28.

COVID-19: Illinois Situation

Diagnosis by Age

Death by Age

### COVID-19: Epidemiology – Co-Morbidity

<table>
<thead>
<tr>
<th>Condition</th>
<th>Proportion</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>0.15</td>
<td>16074/34628</td>
</tr>
<tr>
<td>Chronic cardiac disease</td>
<td>0.05</td>
<td>16044/59776</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>0.05</td>
<td>9736/93764</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>0.05</td>
<td>9710/59776</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.05</td>
<td>9617/93441</td>
</tr>
<tr>
<td>Dementia</td>
<td>0.05</td>
<td>8676/58963</td>
</tr>
<tr>
<td>Asthma</td>
<td>0.05</td>
<td>7476/59745</td>
</tr>
<tr>
<td>Chronic neurological disorder</td>
<td>0.05</td>
<td>6983/59744</td>
</tr>
<tr>
<td>Obesity</td>
<td>0.05</td>
<td>6432/59790</td>
</tr>
<tr>
<td>Rheumatologic disorder</td>
<td>0.05</td>
<td>5927/69326</td>
</tr>
<tr>
<td>Malignant neoplasm</td>
<td>0.05</td>
<td>5699/59745</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.05</td>
<td>3043/59491</td>
</tr>
<tr>
<td>Chronic hematologic disease</td>
<td>0.05</td>
<td>2484/59202</td>
</tr>
<tr>
<td>Liver disease</td>
<td>0.05</td>
<td>1905/59243</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>0.05</td>
<td>1492/68816</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>0.05</td>
<td>422/63430</td>
</tr>
<tr>
<td>AIDS/HIV</td>
<td>0.05</td>
<td>238/56909</td>
</tr>
</tbody>
</table>

Condition present:  
- **No**  
- **Yes**

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## COVID-19 and Risk of Hospitalizations

<table>
<thead>
<tr>
<th>Factor</th>
<th>Unadjusted Rate Ratio (95% CI)</th>
<th>Adjusted Rate Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Medical Condition</td>
<td>2.8 (2.7, 3.1)</td>
<td>2.5 (2.1, 3.0)</td>
</tr>
<tr>
<td>2 Medical Conditions</td>
<td>5.6 (5.2, 6.1)</td>
<td>4.5 (3.7, 5.5)</td>
</tr>
<tr>
<td>3+ Medical Conditions</td>
<td>7.2 (6.6, 7.9)</td>
<td>5.0 (3.0, 6.3)</td>
</tr>
<tr>
<td>Age 45-65 years</td>
<td></td>
<td>1.8 (1.5, 2.2)</td>
</tr>
<tr>
<td>Age &gt;65 years</td>
<td></td>
<td>2.6 (2.1, 3.1)</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td></td>
<td>3.9 (3.3, 4.7)</td>
</tr>
<tr>
<td>Other Race/Ethnicity</td>
<td></td>
<td>3.3 (2.8, 3.9)</td>
</tr>
</tbody>
</table>

COVID-19: Special Populations - Obesity


COVID-19: Symptoms

Symptoms can range from mild to severe illness, and appear 2-14 days after you are exposed to the virus that causes COVID-19.

Seek medical care immediately if someone has emergency warning signs of COVID-19.

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Bluish lips or face
Long-Term Complications of COVID-19

Pain that lingers
A subset of COVID-19 patients experiences ongoing symptoms and complications such as organ damage, and researchers are proposing reasons for some of them (bottom). Scientists are trying to identify such symptoms, how common they are, how long they last, who’s at risk, and how to treat and prevent them.

1 Brain fog
Difficulty thinking can occur after acute COVID-19 infection. The virus may damage brain cells, and inflammation in the brain or body may also cause neurologic complications. Other viral infections can also lead to brain fog.

2 Shortness of breath
Doctors are eyeing lung and heart complications including scarring. Patients who become critically ill with COVID-19 seem more likely to have lingering shortness of breath, but those with mild cases are also at risk.

3 Heart arrhythmia
The virus can harm the heart, and doctors are concerned about long-term damage. How the heart heals after COVID-19 could help determine whether a patient develops an irregular heartbeat.

4 Hypertension
Some patients have high blood pressure after an acute infection, even when cases were relatively mild and people were previously healthy, possibly because the virus targets blood vessels and heart cells.

## COVID-19: Transmission and Masks

<table>
<thead>
<tr>
<th>Chance of Transmission</th>
<th>Asymptomatic COVID-19 Carrier</th>
<th>Uninfected Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGHEST</td>
<td>🧽</td>
<td>🧽</td>
</tr>
<tr>
<td>HIGH</td>
<td>🧽</td>
<td>🧽   🎫</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>🧽</td>
<td>🧽</td>
</tr>
<tr>
<td>LOW</td>
<td>🎫</td>
<td>🧽</td>
</tr>
<tr>
<td>LOWEST</td>
<td>🎫</td>
<td>🧽</td>
</tr>
<tr>
<td>PRACTICALLY NONE</td>
<td>🎫</td>
<td>🎫</td>
</tr>
</tbody>
</table>

6 ft
COVID-19: Transmission and Masks

It only works if you wear it.
Social Distancing: How the US Did Compared to Other Countries

Change in Retail and Recreation Visits

Change in visitor numbers is measured relative to a baseline day; a baseline day is the median value from the 5-week period between Jan 3rd and Feb 6th 2020. This index is smoothed to the rolling 7-day average.

Change in Grocery and Pharmacy Visits

Change in visitor numbers is measured relative to a baseline day; a baseline day is the median value from the 5-week period between Jan 3rd and Feb 6th 2020. This index is smoothed to the rolling 7-day average.

COVID-19: Prevention - Vaccines

Technology used:  
- Nucleic acid
- Viral-vectored
- Subunit
- Virus
- Other

- CanSino: AdV Vector
- Gamaleya: AdV Vector
- SinoVac: CornaVac, protein

Pre-clinical  
Phase 1  
Phase 2  
Phase 3  
Approved

“These are the Top Coronavirus Vaccines to Watch.” Washington Post. 13 October 2020.
COVID-19: RNA/DNA Vaccines

COVID-19: RNA/DNA and Viral Vaccines

Nucleic acid vaccines, developed by...

- Moderna; National Institutes of Health
- Pfizer; BionTech; Fosun Pharma
- AnGes; Osaka University; Takara Bio
- Arcturus Therapeutics; Duke-NUS
- CureVac
- Genevax

Viral vectored vaccines, developed by...

- AstraZeneca; University of Oxford
- CanSino Biologics; Beijing Institute of Biotechnology*
- Gamaleya Research Institute*
- Johnson & Johnson, Beth Israel Deaconess Medical Center
- Institut Pasteur; Themis; University of Pittsburgh CVR; Merck Sharp & Dohme

“These are the Top Coronavirus Vaccines to Watch.” Washington Post. 13 October 2020.
COVID-19 Vaccines: RNA Vaccines

- Moderna/NIH (mRNA-1273): Lipid nanoparticle–formulated, mRNA encoding full-length spike glycoprotein trimer, S-2P, with two proline substitutions in the central helix in the S2 subunit

COVID-19 Vaccines: *RNA Vaccines*

- **Moderna/NIH (mRNA-1273):** Lipid nanoparticle–formulated, mRNA encoding full-length spike glycoprotein trimer, S-2P, with two proline substitutions in the central helix in the S2 subunit

COVID-19 Vaccines: RNA Vaccines

- Moderna/NIH (mRNA-1273): Animal Studies

COVID-19 Vaccines: RNA Vaccines

- BioNTech/Pfizer: Lipid nanoparticle–formulated, nucleoside-modified RNA vaccine candidates
  - BNT162b1: Secreted trimerized SARS-CoV-2 receptor–binding domain
  - BNT162b2: Membrane-anchored SARS-CoV-2 full-length spike, stabilized in the prefusion conformation

COVID-19 Vaccines: RNA Vaccines

- **BioNTech/Pfizer**: Lipid nanoparticle–formulated, nucleoside-modified RNA vaccine candidates

COVID-19 Vaccines: RNA Vaccines

- **BioNTech/Pfizer**: Lipid nanoparticle–formulated, nucleoside-modified RNA vaccine candidates

COVID-19 Vaccines: *Adenovirus Vector Vaccines*

- **AstraZeneca/Oxford ChAdOx1 nCoV-19**: Chimpanzee adenovirus-vectored vaccine expressing the SARS-CoV-2 spike protein

COVID-19 Vaccines: Adenovirus Vector Vaccines

• AstraZeneca/Oxford ChAdOx1 nCov-19

COVID-19 Vaccines: Adenovirus Vector Vaccines

- AstraZeneca ChAdOx1 nCov-9 Vaccine: Animal Data
  Prime
  Prime/Boost
  Placebo

COVID-19 Vaccines: Adenovirus Vector Vaccines

- **JNJ-78436725/Ad26.COV2.S Vaccine:** Non-replicating adenovirus 26 based vector expressing the stabilized pre-fusion spike (S) protein of SARS-CoV-2. Ad26.COV2.S

COVID-19: Protein Vaccines

Weakened and inactivated virus vaccines, developed by...

- Beijing Institute of Biological Products; Sinopharm
  - PC
  - P1
  - P2
  - P3
  - A

- Sinopharm
  - PC
  - P1
  - P2
  - P3
  - A

- Sinovac
  - PC
  - P1
  - P2
  - P3
  - A

- Chinese Academy of Medical Sciences
  - PC
  - P1
  - P2
  - P3
  - A

- Bharat Biotech
  - PC
  - P1
  - P2
  - P3
  - A

Subunit vaccines, developed by...

- Novavax
  - PC
  - P1
  - P2
  - P3
  - A

- Anhui Zhifei Longcom; Chinese Academy of Sciences
  - PC
  - P1
  - P2
  - P3
  - A

- Federal Budgetary Research Institution (FBRI) State Research Center of Virology and Biotechnology "VECTOR"
  - PC
  - P1
  - P2
  - P3
  - A

- Instituto Finlay de Vacunas
  - PC
  - P1
  - P2
  - P3
  - A

- SpyBiotech; Serum Institute of India
  - PC
  - P1
  - P2
  - P3
  - A

“These are the Top Coronavirus Vaccines to Watch.” Washington Post. 13 October 2020.
COVID-19 Vaccines: RNA Vaccines

- Novovax: SARS-CoV-2 spike glycoprotein with Matrix-M1, a saponin-based adjuvant
  - Baculovirus *Spodoptera frugiperda* (Sf9) insect cell-expression system

COVID-19 Vaccines: RNA Vaccines

**Novovax:**

## COVID-19: Time to Vaccination

### Phase 1
- **Phase 1a “Jumpstart Phase”**
  - High-risk health workers
  - First responders
- **Phase 1b**
  - People of all ages with comorbid and underlying conditions that put them at **significantly** higher risk
  - Older adults living in congregate or overcrowded settings

### Phase 2
- K-12 teachers and school staff and child care workers
- Critical workers in high-risk settings—workers who are in industries essential to the functioning of society and at substantially higher risk of exposure
- People of all ages with comorbid and underlying conditions that put them at **moderately** higher risk
- People in homeless shelters or group homes for individuals with disabilities, including serious mental illness, developmental and intellectual disabilities, and physical disabilities or in recovery, and staff who work in such settings
- People in prisons, jails, detention centers, and similar facilities, and staff who work in such settings
- All older adults not included in Phase 1

### Phase 3
- Young adults
- Children
- Workers in industries and occupations important to the functioning of society and at increased risk of exposure not included in Phase 1 or 2

### Phase 4
- Everyone residing in the United States who did not have access to the vaccine in previous phases

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**Equity is a crosscutting consideration:** In each population group, vaccine access should be prioritized for geographic areas identified through CDC’s Social Vulnerability Index or another more specific index.
COVID-19: Time to Vaccination

Advisory Committee on Immunization Practices
Want to Help? Join a Study of SARS-CoV-2/COVID-19 Vaccine!

• Current COVID-19 Vaccine Trials
  o Multiple Centers in Chicago Participating
  o Priority given to high risk populations
    ▪ Older adults
    ▪ Minorities
    ▪ Essential employees
  o Sign Up Online
    ▪ https://www.coronaviruspreventionnetwork.org

Help find a vaccine for COVID-19!

We're looking for:
- Adults aged 18 and older
- People who are more likely to be exposed to COVID-19, including:
  - People with underlying medical conditions
  - People with greater chances of exposure at their job
  - People who live or work in elder-care facilities
  - People over age 65
  - People who work in jails or prisons
  - People from racial and ethnic groups that have been impacted in greater numbers by the epidemic, such as African Americans, Latinx, and Native Americans

If you are interested in being contacted about COVID-19 vaccine and other prevention studies, please register in the online Northwestern COVID Prevention Trials Registry

https://is.gd/NUVaccineStudy
You can also reach us via email at NUVaccineStudy@northwestern.edu or by calling 312-695-5012.
COVID-19: Management Options

A. ACE2
- Arbidol
- Favipiravir
- Remdesivir
- Lopinavir
- Ritonavir

Genomic replication
Subgenomic (nested) transcription
Nucleocapsid - Spike
Membrane - Envelope

B. Chloroquine/Hydroxychloroquine
- Inhibit TLR7/TLR9
- Enhance antigen processing
- Enhance Treg function

- Perturbs lysosomal acidification & viral genome release
- Disrupts endosome maturation & viral budding

C. Inflammatory monocytes/macrophages
- TNF-α, CCL-2, IL-6, IL-8
- Gimsilumab (target: GM-CSF)
- GM-CSF
- IL-6

- Tocilizumab (target: IL-6R)
- Sarilumab (target: IL-6R)
- Siltuximab (target: IL-6)

D. Recovered COVID-19 pt
- Convalescent plasma
- Monoclonal Ab
- Polyclonal Ab
- Single-domain Ab
- ACE2-Ig

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COVID-19: What Does the Future Hold?
Influenza: What We Normally See

Estimated U.S. Influenza Burden, By Season (2010-2019)

Deaths
Hospitalizations
Illnesses

2010-2011: 21,000,000
2011-2012: 9,300,000
2012-2013: 20,000,000
2013-2014: 30,000,000
2014-2015: 30,000,000
2015-2016: 30,000,000
2016-2017: 30,000,000
2017-2018*: 45,000,000

*Estimates for these seasons are preliminary and may change as data are finalized.
What We Know from the Southern Hemisphere

[Graphs showing weekly flu cases and deaths per 100,000 people for Paraguay, South Africa, Argentina, Australia, Chile, and New Zealand.]

*As reported to WHO's Global Influenza Surveillance and Response System

Influenza Vaccines: *Knowing Which Vaccine to Get*

• Types of Influenza Vaccine
  - Standard Quadravalent Influenza Vaccine
  - High Dose Quadravalent Influenza Vaccine
  - Adjuvanted Quadravalent Influenza Vaccine
  - Cell Culture Vaccines
  - Recombinant Vaccine
  - Live Attenuated Vaccine
Influenza Vaccine: Composition and Recommendations

• 2020-2021 Influenza Vaccine Composition
  o A/Hawaii/70/2019 (H1N1)pdm09-like virus (updated)
  o A/Hong Kong/45/2019 (H3N2)-like virus (updated)
  o B/Washington/02/2019 (B/Victoria lineage)-like virus (updated)
  o B/Phuket/3073/2013-like (Yamagata lineage) virus

• Current Recommendations for Vaccine
  o All individuals ≥ 6 months of age should be vaccinated
  o September and October are good times to get vaccinated
  o Contraindications: Egg allergy, Guillain-Barre Syndrome due to vaccine
Key Take Home Points

• Get your flu shot (now is the time)
• Where a mask whenever not at home
• Expect a large second wave of disease this winter
• COVID-19 is real
  o Over 8,232,367 cases in the US
  o Over 438,967 (~5%) hospitalizations (39,230 currently hospitalized)
  o Over 22,662 in ICU (5% of hospitalized; 8,178 currently in ICU)
  o Over 212,678 deaths (2.5% mortality, >20% if in ICU)
  o Obesity, hypertension and diabetes are key risk factors
Help find a vaccine for COVID-19!

We’re looking for:

- Adults aged 18 and older
- People who are more likely to be exposed to COVID-19, including:
  - People with underlying medical conditions
  - People with greater chances of exposure at their job
  - People who live or work in elder-care facilities
  - People over age 65
  - People who work in jails or prisons
  - People from racial and ethnic groups that have been impacted in greater numbers by the epidemic, such as African Americans, Latinx, and Native Americans

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Questions?
Sign Up to Participate in COVID-19 Vaccines

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