Overview of COVID-19 Pandemic

HSEG 505 - Systems Engineering for Healthcare
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What is a Pandemic?
What is a Pandemic?

An event in which a disease spreads across several countries and affects a large number of people (cdc.gov)

- First known use of the term in 1666 (“Pandemick/Endemick”).
- Noah Webster listed epidemic and pandemic as synonymous terms in his 1st ed. of the dictionary in 1828.
- By 1918, “pandemic” became its own distinct common term.

(Morens et. al, 2009).
Epidemic vs Pandemic

A disease that spreads quickly in a specific region.

A disease that spreads quickly across a large geographical area, like a continent or the world.

Adapted from https://www.facebook.com/Dr.ReddysLaboratories/posts/you-know-that-covid19-is-a-pandemic-but-whats-the-difference-between-a-pandemic-/296159968484972/
History of Pandemics
History of Biggest Pandemics

The Black Death (1347 - 1351 AD)

- $\frac{1}{3}$ - $\frac{1}{2}$ of the European population dead (25 million people) (Black, 2020)
- Caused by the bacteria *Yersinia pestis* found in small mammals & fleas (Freq, 2019)
- 2 clinical forms: (Plague, 2020)
  - Bubonic - 30-60% mortality rate
  - Pneumonic - 100% mortality rate
- Believed to have originated in China, spread westward to Africa, the Middle East & Europe by merchant ships (Wheelis, 2002)
- Genetic evolution of human bodies & the bacteria (DeWitte, 2014)
- No Vaccines - still infecting people (Plague, 2020)

Adopted from https://www.nbcnews.com/health/health-news/plague-came-europe-just-once-stayed-study-finds-n588461
Adopted from https://www.npr.org/sections/coronavirus-live-updates/2020/04/10/831875297/burials-on-new-york-island-are-not-new-but-are-increasing-during-pandemic
History of Biggest Pandemics

The Spanish Flu (1918-1920)

- 500 million people affected, about 40 million deaths worldwide
  - 2% of total pop ("1918 Pand.", 2019)
- Caused by a strain of influenza of avian origin
- Origins are unknown (despite the name) ("1918 Pand.", 2019)
- 10-20% mortality rate (healthy young adults aged 20s-30s fell victim)
- Pandemic ended as people gained immunity.
- H1N1 virus over time, morphed into a less deadly strain of seasonal flu (Taubenberger, 2006)

Adopted from https://academic.oup.com/cid/article/47/5/668/296225
History of Biggest Pandemics

SARS (February 2003 - May 2003)

- Severe Acute Respiratory Syndrome -
  - Caused by a coronavirus (SARS-associated coronavirus). (Severe, 2017)
- Originated in China from palm civets (Chew, 2007)
- Airborne virus, also spread by surfaces (similar to influenza) (Severe, 2017)
- Mostly affected 25-70 year old population (3% mortality rate) (Severe, 2017)
- In 2003, 8095 infected, 774 deaths (“SARS”, 2017)
- Since May 2003, the SARS virus (SARS-CoV-1) was reduced by viral morphing and implementation of public health measures (“Why SARS”, 2020)
COVID-19: Origins & Timeline
COVID-19

- COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
- First appeared in Wuhan, China, in December 2019 (WHO, 2020)
- An early study of 41 initially identified confirmed cases showed that 66% of the cases had a link to the Huanan seafood market (Huang et al., 2020)
- Early hypotheses thought it may be originated from wild animals in the market
- SARS-CoV-2 was already spreading in France in late December 2019 (Deslandes et al., 2020)
- SARS-CoV-2 was detected in Barcelona sewage long before the declaration of the first COVID-19 case (Chavarria-Miró et al., 2020)
- The Market is likely to be a point of amplification (WHO, 2020)
- Origin of Covid hasn’t been fully identified yet (WHO, 2020)
## COVID-19 Timeline

### December 2019 (China CDC, 2020)

- **29th**: Four cluster of mysterious pneumonia cases, which all related with Huanan Seafood Market were detected
  - Hospital reported to District CDC
  - Wuhan CDC staff initiated a field investigation
- **30th**: National Health Authorities aware
- **31st**: Reported to WHO (WHO, 2020)
  - Chinese public aware
    - 27 mysterious pneumonia cases
    - No evidence of human-to-human transmission

### January 2020

- **01st**: The Huanan seafood market closed (China CDC, 2020)
- **07th**: China isolated the sample of novel coronavirus (WHO, 2020)
- **12th**: The genetic sequence was shared with the world (WHO, 2020)
- **20th**: USA reported first case (WHO, 2020)
  - Dr. Zhong confirmed there is human-to-human transmission (CCTV News, 2020)
- **23rd**: Wuhan entered lockdown (China CDC, 2020)
- **26th**: Thirty provincial-level regions have activated first level emergency response, covers 1.2 billion people (Xinhua Net, 2020)
- **30th**: WHO declared world health emergency (WHO, 2020)

### March 2020

- **11th**: WHO declared pandemic (WHO, 2020)
- **26th**: President Trump and President Xi discussed the global response to Covid-19 over the phone

### April 2020

- **08th**: China ended 76-day lockdown of Wuhan (China CDC, 2020)
Origins: Lab-Made or Natural Transmission?

Genetic Overview of COVID-19

- COVID-19 Spike Protein Receptor Binding Domain (RBD), and The ACE2 receptor in human cells (Wan, Shang, Graham, Baric, & Li, 2020)
- SARS-CoV and COVID-19
- 6 amino acids (AA) in COVID-19 RBD linked to high affinity for ACE2 receptor (Andersen, Rambaut, Lipkin, Holmes, & Garry, 2020)
- Polybasic cleavage site in the Spike protein & flanking O-linked glycans' impact on transmissibility and pathogenesis (Andersen et al. 2020)

COVID-19 VS. SARS-CoV
An act of purposeful manipulation would have known from SARS-CoV genetic data what a high affinity interaction looks like.
(Andersen et al. 2020)

COVID-19 Mutations
Through vast genetic database searches, Coronavirus is shown to not be derived from any previously used virus backbones.
(Andersen et al. 2020)

Pre-Zoonotic Natural Selection
Bats and Malayan Pangolins show similar RBD. Selectivity for human-like ACE2 receptors.
(Andersen et al. 2020)

Post-Zoonotic Natural Selection
Polybasic cleavage site & O-linked glycans can only be explained by human-to-human transmissions. There must have been undetected time when the virus infected humans before these mutations.
(Andersen et al. 2020)
COVID-19 in Other Countries
China & Hong Kong

A modelling study co-authored by Chen et al. calculated that the public health actions undertaken by China between Jan. 29th and Feb. 29th may have prevented 1.4 million infections and 56,000 deaths.

**Initial Response:**  (Liu et al., 2020)

- In 2003, developed “Regulations on Preparedness for the Response to Emergent Public Health Hazards”.
- Immediate suspension of travel and closure of public places
- Two emergency specialty field hospitals **built within 1 month**, to address insufficient medical resources
- Enterprises donated large sums of money to Wuhan city
  - Chinese National Petroleum Corporation **transformed production lines to produce medical protective equipment and ventilators**
- Utilized **big data and communication technology** - QR code & 5G

**Major Key Lessons from the Government And Citizens**  (Burki, 2020)

- Transparency
- Unified Efforts
- Culture
China & Hong Kong

Cultural Response:

- Confucianism
  - Advocates duty to society over individual needs
  - Commitment to the greater good is ingrained in society
- Stark contrast between US, and China & Hong Kong
  - Absence of hyper-individualism that characterizes parts of U.S.
  - Accepting that disease control is based on science
  - The practice of personal protective behaviors

- Hong Kong
  - Since June 2016, the city has been under a political crisis involving “super-spreader” events
  - Despite political unrest, citizens temporarily paused protesting events

Covid-19 Data - U.S. vs China
(taken from Nov. 22 2020)

<table>
<thead>
<tr>
<th></th>
<th>Deaths</th>
<th>Death Rate*</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>253,307</td>
<td>77.4</td>
<td>11,860,676</td>
</tr>
<tr>
<td>China</td>
<td>4,742</td>
<td>0.3</td>
<td>91,979</td>
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*per 100,000

New Cases

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<tr>
<td>U.S.</td>
<td>24 JAN</td>
<td>20 NOV</td>
<td></td>
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<td>China</td>
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Adapted from https://www.bbc.com/news/world-51235105
Sweden

Rationale (Carlson, 2020)
Evidenced based, Flexible, Voluntary, Sustainable

General Strategy (Carlson, 2020)

- Shared responsibility, based on advice from expert agencies
- Protect the risk groups
- Hygiene routines
- Social distancing
  - The binding regulations include:
    - No nursing home visiting
    - Distance education for secondary schools and partial closure of universities
    - No gathering more than 50 people
  - Clearly communicated recommendations and advice to the public include:
    - Elderly shall stay at home
    - Stay home if you have Covid symptom
    - Avoid unnecessary travel
- Kindergartens and primary schools remain open
- Workplaces remain open while working from home is strongly suggested
- Restaurants and cafés must practice physical distancing while opening for business
Research shows that in Sweden 89.1% of those who died were 70 years or older; only 2.3% were less than 60 years old. (Kavaliunas, Ocaya, Mumper, Lindfeldt, & Kyhlstedt, 2020)

Swedish perspective may offer invaluable insights into reopening education facilities worldwide (Kavaliunas et al., 2020)

Protecting the old and vulnerable (Kavaliunas et al., 2020)
Sweden (cont.) - Culture Aspect

- **Administrative Independence** (Norberg, 2020)
  - Government agencies are independent
  - Ministerial rule is prohibited in Sweden (Kavaliunas et al., 2020)
  - The national agencies do not have enforcement of the regions and municipalities unless mandated by parliament (Kavaliunas et al., 2020)
  - Follow the advice by public agency instead of political decision from the government.

- **High level of trust in Swedish culture** (Norberg, 2020)
  - According to the World Values Survey (Esteban, 2016), there is a high level of interpersonal trust between Swedes, and also a high level of trust in public authorities.
  - 80% public trust with PHA and healthcare (Kavaliunas et al., 2020)
  - 87% high level of confidence to researchers and experts (Kavaliunas et al., 2020)

- **Population Structure**
  - As of Dec.31, 2019, the total population is 10,327,589, 25.5% with foreign background (Statistics Sweden, 2020)
  - In 2016, 52% of all Swedish homes are made up of one residence, the highest proportion in EU (Eurostat, 2017)
New Zealand “Team of 5 Million”

Initial Response & Strategy
(Jefferies et al., 2020) & (Baker, Wilson, & Anglemyer, 2020)

- The country began implementing its influenza pandemic plan in early February before the appearance of the first case (Feb 26).
  - Included preparing hospitals for influx of patients & instituting border control policies to delay the pandemic’s arrival.
- The government’s approach changed with the WHO-China Joint Commission’s report on COVID behaving more like SARS than influenza.
- By mid-March, the government implemented a strict nationwide lockdown that lasted 7 weeks as a response to lack of testing and contact-tracing capacity.
- Last known case of COVID was identified & isolated - Early May
- Country declared COVID-free - June 8th
  - 103 days after first identified case
  - Country declared COVID-free - June 8th

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<td>79.1</td>
<td>12,540,809</td>
</tr>
<tr>
<td>NZ</td>
<td>25</td>
<td>0.5</td>
<td>2,039</td>
</tr>
</tbody>
</table>

Initial Response & Strategy (Wang, Ng, & Brook, 2020)

- On constant alerts & ready to act on epidemics arising from China ever since SARS epidemic in 2003.
- Focused on case identification, containment, and resource allocation to protect public health.
- Integrated national health insurance database with immigration and customs database to create big data for analytics.
- Utilized QR code scanning & online travel history to classify travelers’ infectious risks.
  - High risk travelers were quarantined at home and tracked through their phones.
- Toll free number “1922” served as hotline for citizens to report symptoms in selves or others.
- Government addressed issue of disease stigma by providing food, health checks, and encouragement for those quarantined.

Covid-19 Data - U.S. vs Taiwan
(taken from Nov. 25 2020)

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<td>79.1</td>
<td>12,540,809</td>
</tr>
<tr>
<td>Taiwan</td>
<td>7</td>
<td>0.0</td>
<td>618</td>
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</table>

*per 100,000

New Cases

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<td>Taiwan</td>
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New Zealand & Taiwan - Lessons Learned / Culture

New Zealand (Baker et al., 2020)
● Early government action linked to science-based risk assessment.
● Prime minister Jacinda Ardern provided empathetic leadership and effectively communicated fundamental messages.
  ○ Fighting the pandemic is the work of a “unified team of 5 million”.
  ○ High public confidence in the government & compliance of the population.

Taiwan (Wang et al., 2020)
● Daily press briefings by minister of health
● Regular broadcasts by Vice President Lai Ching-te
  ○ Available online
  ○ Broadcast information included when and where to wear a mask, importance of handwashing, dangers of hoarding PPE, etc.
● Moved to educate & reassure the public, while fighting misinformation presented by media.
Flattening the Curve
"Reducing the number of cases that are active at any given time, which in turn gives doctors, hospitals, police, schools and vaccine-manufacturers time to prepare and respond, without becoming overwhelmed"  
(New York Times, 2020)
COVID-19 & Hospital Capacity

Where COVID-19 Cases Are Straining Hospital Capacity

As of Nov. 7

5% = Start paying attention
10% = System overwhelmed

Adopted from https://www.npr.org/sections/health-shots/2020/11/10/933253317/covid-19-hospitalizations-are-surgeing-where-are-hospitals-reaching-capacity
How Do We “Flatten the Curve”?

United States

- 14-day quarantine for those who are sick or have exposure
- Personal Protective Equipment (PPE)
- Social distancing - 6 ft. apart
- Closures
  - School
  - Work
  - Restaurant
  - Gym
- Stay at home order
- Travel ban

Contain **current** outbreaks & prevent **future** outbreaks by limiting **unnecessary** activities

Adopted from https://www.worldometers.info/coronavirus/country/Unitedstates/
International Response to “Flatten the Curve”

Taiwan

- Closed borders to international travel
- Banned export of PPE
- Mask mandates
- Extensive contract tracing
- SIM tracking of current COVID-19 cases

Due to its response, Taiwan was able to avoid a total lockdown and has remained in a strong economic position

Adopted from https://www.worldometers.info/coronavirus/country/taiwan/

(Summers et al. 2020)
International Response to “Flatten the Curve”

**Taiwan**

Due to its response, Taiwan was able to avoid a total lockdown and has remained in a strong economic position.

**United States**

Adopted from https://www.worldometers.info/coronavirus/country/taiwan/

Adopted from https://www.worldometers.info/coronavirus/country/unitedstates/
International Response to “Flatten the Curve”

New Zealand

- **Closed borders** three weeks after first case
- **Closed non-essential** businesses
- **Initiated “Level Four” lockdown**
  - No interactions with individuals outside of own household

New Zealand’s initial response was more aggressive than Taiwan but allowed a significant decrease of COVID-19 transmission by May 2020

Adapted from https://www.worldometers.info/coronavirus/country/Newzealand/

(Summers et al. 2020)
New Zealand’s initial responsive was more aggressive than Taiwan but allowed a significant decrease of COVID-19 transmission by May 2020.
Preparedness
Issues with Mass Testing and PPE Supplies

● Many issues w/ testing & acquiring mass amounts of PPE at start of pandemic
  ○ Demand outweighing supply for both tests & PPE
    ■ Delays in shipments to meet demand
    ■ Prevented clinicians from properly quarantining and treating patients
● Increased demand for testing forced developers to work overtime
  ○ Roche - first approved commercial developer for SARS-CoV-2 Test
    ■ Currently provides ~15 million tests/month (Ketchum, 2020).
● Ideally want to test entire population multiple times
  ○ Supply chains working to provide more tests
  ○ Potential need for 100-200 million tests in the U.S. alone for the remainder of this year (Ketchum, 2020).
Testing Trends in the US

Adopted from: https://coronavirus.jhu.edu/testing/individual-states
Types of Tests for COVID-19 Detection - Most Common

Two common forms of COVID-19 testing (FDA, 2020)

1. **Viral Test**
   
   i. **RT-PCR Tests**: detect virus’ genetic material (RNA)
      
      - Considered the gold standard & most accurate
      - Sensitivity of >98%
      - Nasopharyngeal swab, nasal or throat swab, saliva
        
      a. 1 day-7 days for results
   
   ii. **Antigen Tests**: detect specific proteins from virus
      
      - Sensitivity of rapid antigen tests generally lower than RT-PCR
      - First antigen tests to receive FDA EUAs demonstrate sensitivity ranging from 84.0% to 97.6% (CDC, 2020).
      - Typically used in rapid test (15-30 min)

2. **Antibody Test**
   
   ○ Reveals past infection
   ○ Looks for antibodies made by immune system in response to a threat (i.e. a specific virus)
      
      - Antibodies can take several days or weeks to develop after having infection
      - Should not be used to diagnose COVID-19
Types of Tests for COVID-19 Detection

- **Grouped “Pooled” Testing** - grouping a population of people into subsections & sampling subsections via a pool of blood samples (CDC, 2020).
  - Reduces amount of tests needed
  - More efficient, less waiting
  - Big reduction in costs
    - Single test = $100+
    - Could save up to 80% of costs from testing
  - Uses RT-PCR Method
    - Research shows pooled testing is about as accurate as individual testing in pools as large as 8 people (Broadfoot, 2020).
**Ventilators**

**Ventilators** *(Yale Medicine, 2020)* - machines that pump air into a patient’s airways when they are unable to breathe adequately on their own

- COVID quickly overwhelmed many day-to-day operational capabilities
- Government had to work efficiently to meet demand

**The Strategic National Stockpile (SNS) -** *(CDC, 2020 & CHS, 2020)*

- Ventilator training educates healthcare workers on available portable mechanical ventilators maintained by the CDC *(CDC, 2020)*.
- If more ventilators are needed health facilities should work through the state public health department *(CHS, 2020)*.
- July & August 2020 - Hospitals and state & local health dept. Began tracking and publicly displaying the # of ventilators available *(CHS, 2020)*.
- HHS (Dept. of Health & Human Services) reported SNS ventilator stockpile replenished through Defense Production Act *(CHS, 2020)*.
  - Approx. 120,000 ventilators are available for distribution as needed
Training of Healthcare Workers

Dr. Movahedi on Training of Healthcare Workers & Disposing of PPE Waste at Kaiser Permanente Orange County

“Once the pandemic hit, what we did at Kaiser was upscale everyone’s position. We put the hospital into the teams that were intensivist (physician caring for critically ill patients) and hospitalists. They worked side by side and what happens is, the patients in more chronic states were followed by the hospitalists and more acute patients are followed by the intensivists. Thankfully, COVID-19 is not a complex disease, so what was run in the ICU setting could be ran in the rest of the medical ward. The non-COVID patients were brought in to doctors who were mostly clinical practice. I’m a nephrologist, but during COVID I took care of every dialysis patent that was in the hospital and became their primary doctor.

In terms of disposing of waste, in the early phases of COVID-19, we would preserve our masks and recycle it. At this point, we just dump the PPE that is not rewearable.” (Movahedi, 2020)
Prevention Measures at the Workplace

U.S. Dept. of Labor - Occupational Safety & Health Administration

- Provides guidance on preparing workplaces for COVID-19
  - Implement Workplace Controls
- Engineering Controls: air filters, physical barriers, etc.
- Administrative Controls: proper worker training, switching to virtual communication, etc.
- Safe Work Practices: promoting personal hygiene (i.e. handwashing signs in restroom, alcohol-based sanitizer)
- Personal Protective Equipment: masks, gloves, etc.
Cultural Changes
Cultural Changes

- **Greetings**
- **Group Meetings**
  - Shifted to virtual interactions
  - Social distancing (6 ft. apart)
- **Business Changes**
  - Working from home
  - Essential vs. Non-Essential
  - Limited number of people inside a confined space
- **Holiday Changes/Cancellations**
  - What does cancelled mean?
  - How can we observe holiday traditions safely?
- **Challenges Against Changes**
  - Mental health
  - Unable to visit loved ones in the hospital
  - People refusing to abide to social distancing, wearing a mask
  - Individual > group mentality

COVID & Education

- Some students do not have access to technology or WiFi
- Different learners may have difficulty adapting to online learning (Herold, 2020)
  - Visual & Spatial
  - Physical or Kinesthetic
  - Social & Interpersonal
- Some schools still meet in person
  - Teachers have to get creative w/ safety measures
    - Out of pocket
- Limited resources
  - Students depend on school lunches
  - Less physical activity
  - Guidance/college counselors
- Teachers are not accustomed to teaching online
  - Older teachers have difficulty w/ technology
- Transition to online learning was immediate for both students & teachers
  - No contingency plan set in place prior to COVID

Adapted from https://www.edweek.org/ew/articles/2020/04/10/the-disparities-in-remote-learning-under-coronavirus.html
COVID & Education

Percentage of districts leaders who said students' lack of technology access is a major challenge to teaching during Coronavirus-related closures (March 24 & 25)

- 25% or less low-income students: 21%
- 26-50%: 48%
- 51-75%: 58%
- >75%: 64%

SOURCE: EdWeek Research Center

Percentage of district leaders who said their district was offering live classes in which students interact with each other and with teachers during Coronavirus-related closures (March 24 & 25)

- 25% or less low-income students: 29%
- 26-50%: 25%
- 51-75%: 13%
- >75%: 14%

SOURCE: EdWeek Research Center

COVID & Education

- Overall lack of motivation in all grade levels from pre-K to post-grad
  - Accountable for own education
  - Consequences?
- Students do not get social interaction with those outside of their household & are becoming more sedentary
- Low-income students & younger students are falling behind
  - Education gap is widening

Percentage of teachers who said their students were essentially "truant" during Coronavirus-related closures (April 7 & 8)

- 25% or less low-income students: 12%
- 26-50%: 21%
- 51-75%: 25%
- >75%: 32%

Adopted from https://ec.europa.eu/education/news/coronavirus-online-learning-resources_en
Economic Damage & Recovery Attempts
Economic Damage

- **National Economic Damage**
  - GDP - $1,940 billion for immediate fiscal impulse (9.1%), $561 billion in deferrals (2.6%), $560 other liquidity and guarantee measures (2.6%) (Anderson, Bergamini, Brekelmans, Cameron, Darvas, Jimenez, . . . Midoes, 2020).

- **Hospital Economic Damage**
  - Loss of revenue due to no elective surgeries/procedures
  - High cost for projects
    - convert space to COVID sectors, virtual health, and other virtual necessities for patients
  - High cost for ventilators and PPE for hospital staff

(Effect of COVID, 2020)
Recovery Attempts

● National Recovery Attempts
  ○ As infection rates slowly decreased, the government began allowing businesses to open up with restrictions (State of California, 2020) - as a result:
    ■ Job growth gradually increased (Crump, Placheril, Berube, 2020)
    ■ Unemployment soared as quarantine began, but is slowly declining (“COVID-19 Recovery”, 2020).
    ■ National housing insecurity has decreased from 26.5% to 8.5% since April (“COVID-19 Recovery”, 2020)

● Hospital Recovery Attempts
  ○ Marketing to let patients know that hospitals are safe
  ○ Bring up surgery numbers
    ■ Having COVID testing set up for patients 2 days before procedure/surgery
Treatments
FDA SUPPORTED TREATMENTS & CURRENT STUDIES

MONOCLONAL ANTIBODY THERAPY ANTIBODY LY-COV555 (BAMLANIVIMAB)

- Published in *The New England Journal of Medicine*
- Study by Cedars-Sinai Medical Center, Los Angeles
- Phase 2 randomized clinical trial (N = 452) (FDA, 2020)
  - Randomly given single intravenous infusion of neutralizing antibody LY-CoV555 of varied doses
    - 700 mg
    - 2800 mg
    - 7000 mg
    - 0 mg (placebo)
- Criteria
  - Outpatients with recently diagnosed mild or moderate symptoms
    - Not for patients who are hospitalized with severe symptoms or who require oxygen therapy
- Result
  - 2800 mg dose most promising
  - Appeared to accelerate natural decline in viral load over time
  - % of patients who had COVID-19 related hospitalization/ED visit
    - LY-CoV555 group = 1.9% (~9 patients)
    - Placebo group = 6.3% (~29 patients)
FDA SUPPORTED TREATMENTS & CURRENT STUDIES

DEXAMETHASONE SODIUM PHOSPHATE (DECADRON)

- Used for SARS, Middle Eastern respiratory syndrome (MERS), severe influenza and community-acquired pneumonia (The RECOVERY Collaborative Group, 2020)
- 176 National Health Service organizations in the United Kingdom and was supported by the National Institute for Health Research Clinical Research Network

Criteria
- Hospitalized patients with suspected or confirmed SARS-CoV-2 and “no medical history that might, in the opinion of the attending clinician, put patients at substantial risk if they participate”

Distribution (N=6,425)
- N = 2,104 received 6 mg orally or intravenously for up to 10 days
- N = 4,321 received 0 mg (just received usual care)
  - 1,028 of 6,425 (16%) were receiving invasive mechanical ventilation or extracorporeal membrane oxygenation
  - 3,855 of 6,425 (60%) were receiving oxygen only (with or without noninvasive ventilation)
  - 1,542 of 6,425 (24%) were receiving neither

Table 2. Primary and Secondary Outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Dexamethasone (N = 2104)</th>
<th>Usual Care (N = 4321)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality at 28 days</td>
<td>482/2104 (22.9)</td>
<td>1110/4321 (25.7)</td>
</tr>
<tr>
<td>Discharged from hospital within 28 days</td>
<td>1413/2104 (67.2)</td>
<td>2745/4321 (63.5)</td>
</tr>
<tr>
<td>Invasive mechanical ventilation or death†</td>
<td>456/1780 (25.6)</td>
<td>994/3638 (27.3)</td>
</tr>
<tr>
<td>Invasive mechanical ventilation</td>
<td>102/1780 (5.7)</td>
<td>285/3638 (7.8)</td>
</tr>
<tr>
<td>Death</td>
<td>387/1780 (21.7)</td>
<td>827/3638 (22.7)</td>
</tr>
</tbody>
</table>

Adapted from https://www.nejm.org/doi/full/10.1056/NEJMoa2021436
FDA SUPPORTED TREATMENTS & CURRENT STUDIES

ANTIVIRAL DRUG “VEKLURY” (REMDESVIR)

- FDA approved October 2020 (“FDA Approves First Treatment for COVID-19”, 2020)
- Criteria
  - Adults & children ages 12 and older, and weighing at least 88 lbs
  - Hospitalized for COVID-19 with mild to severe symptoms
- Clinical trial suggests drug may *modestly speed up recovery time* (decrease number of days hospitalized) > *lower mortality rate as there is correlation between # of days hospitalized and patient outcome*
  - Analysis of data from 3 randomized clinical trials
    - Trial 1: N = 1,062
    - Trial 2: N = 384
    - Trial 3: N = 397
FDA SUPPORTED TREATMENTS & CURRENT STUDIES

CONVALESCENT PLASMA

- Analysis from Expanded Access Program (EAP), led by the Mayo Clinic
  - 35,000 patients were given convalescent plasma to treat COVID-19
- Study suggest therapy may reduce risk of dying
  - Patients who received plasma within 3 days of diagnosis were less likely to die than patients who received plasma later in course of disease
- Problem?
  - No control group
  - All patients eligible were given treatment under EAP

TRUMP’S COVID TREATMENT

Treatments (Gallagher, 2020)

- Decadron (Dexamethasone)
- Monoclonal Antibody Therapy - Regeneron
  - Currently available to clinical trial participants
  - Difficult to manufacture
  - Other monoclonal antibodies = thousands of dollars
- Remdesivir
  - $3,120 - private insurers
  - $2,340 - public programs (e.g. Medicare, Medicaid)

Cost Comparison (Kliff, 2020)

- National median charge for COVID hospitalization:
  - 23-30 age group - $34,662
  - 51-60 age group - $45,683
- Hospitalized patients have received bills upward of $400,000
- Charge range for COVID hospitalization for 60+ patient: $26,821 to $193,149
- Trump’s treatment cost >$100,000
  - Federal government covered Trump’s cost of care
Superspreader Events
What is a Superspreader Event?

An event in which a significant number of individuals become infected from one event that is more than usual

- 70-80% of infections can be traced to 10-20% of cases (Al-Tawfiq & Rodriguez-Morales, 2020)
- 18.7 times more likely to contract Covid-19 indoors (Frieden & Lee, 2020)
- Possible Qualifications:
  - Immune Suppression
  - Increased Disease Severity/Viral Load
  - Pre-existing Conditions
  - Asymptomatic Individuals
  - Extensive Social Interactions

Adapted from: https://www.berkeley.edu/news/media/releases/2005/11/16_super.shtml
Superspreader Events

Notable Statistics

- Droplets can spread up to 15 ft from source (Frieden et al., 2020)
- 40% of infections are spread by asymptomatic persons (Associated Press, 2020)
- Scientists studying three months of contact tracing data from Hong Kong estimated that 19% of people infected were responsible for 80% of the spread of coronavirus infections. (Associated Press, 2020)

Major Events:

- General
  - Parties
  - Concerts/Festivals
  - Weddings
  - Bars/Restaurants
- Government & Political
  - Rallies
  - Protests
  - Ceremonies
  - Campaign Events

Superspreader Event Map

12/23/19-3/14/20

12/23/19-4/12/20

12/23/19-11/13/20

Notable Events

- **Amy Coney Barrett Ceremony** (Impelli, 2020)
  - At least 37 cases confirmed within 12 days of event
- **Trump Rallies** (Bernheim, Buchmann, Freitas-Groff, & Otero, 2020)
- **Sturgis Bike Rally in N. & S. Dakotas** (Shammas & Sun, 2020)
  - 330+ cases and one death directly linked
  - Believed to have contributed to the spike in Covid-19 cases across the Midwest in the weeks following
- **Nursing Homes in New York** (Ferre-Sadurni & Harris, 2020), (New York State Department of Health, 2020)
  - 6,200 Covid-19 deaths linked to nursing homes
  - Controversy over what caused this
- **Chainsmokers, Chase Rice, & Chris Janson Concerts** (Brown, 2020)
Resistance to Vaccine
WHO’s Strategic Advisory Group of Experts (SAGE) calls, resistance to vaccine, “Vaccine hesitancy,” and defines it as a “delay in acceptance or refusal of vaccination despite availability of vaccination services...”

(MacDonald, 2015)
Worldwide Vaccine Resistance

In a 2020 *Nature* study, 13,426 people in 19 countries were surveyed to determine potential acceptance rates of a COVID-19 vaccine. (Lazarus, 2020)

- 71.5% of participants reported they would likely take a COVID-19 vaccine.
- 61.4% reported accepting their employer’s recommendation.
- Differences in acceptance rates ranged from almost 90% (in China) to less than 55% (in Russia).
- Respondents reporting higher levels of trust in information from government sources were more likely to accept a vaccine and take their employer’s advice to do so.
- Men were less likely than women to agree to get vaccinated.
- People with higher education levels (bachelor’s or postgraduate degree) were more likely to accept the vaccine.
Vaccine Resistance in the U.S.

**Anti Vaxxers:** Believe vaccines cause harm to their children (autism). Disputed by a *JAMA* study that analyzed 95,000 children. (Jain, 2015)

**Religion:** Believe the pandemic is God’s will; against their religious practice to vaccinate.

**Naturalists/Philosophers:** Vaccines are unnatural and we have no right to interfere with nature.

**Racial/Ethnic Groups:** Fear that the government is using them as test subjects (historical context: The Tuskegee Syphilis Experiment). (Jones, 1993)

**Online Conspiracy Theorists:** Government is attempting to implant us with biochips.
Solutions to Resistance

**Soft Solutions**
- CDC proposals - number of lives vs. number of life years vs. people with underlying health conditions.
- Lottery system based on dob, quarterly birth dates, SSNs, or region.

**Hard Solutions**
- 100% compliance China; 97% Sweden (Carlson, 2020)
- Mandate all frontline-healthcare providers, federal employees, teachers, peace officers, and other civil servants be vaccinated as a condition of their employment.
Movements Instead of Mandates!

Use social media to promote unity and motivate people to get vaccinated!

**Pros:** Identify those that have been vaccinated, social pressure to vaccinate, promote unity with an ultimate goal of herd immunity.

**Cons:** Not mandatory (delayed herd immunity), potentially controversial (identifier).
COVID-19 Vaccination Research & Delivery
Vaccinations

Access

Production

Distribution
Access Brainstorm

- Groups Prioritized
- Reticence/Hesitation
- Opt-Out
- Political/Company Alliances
- Socioeconomic
- Information Intake
- Remote Areas/Rural Communities

Illustration rendered by Hassan, K, Christensen-Levy, H and Raelene Belisle, 2020
Distribution Schedule

- **Schedule**
  - 1st: HCP
  - 2nd: Areas with the highest incidence of COVID-19 and work down the list
    - Population with highest likelihood of transmission
    - High-risk/underlying conditions

- **Considerations**
  - Climate
  - Storage (Grady, 2020)
    - Pfizer: -94°F
    - Moderna: -4°F
  - Shelf life: 30 days in refrigerator; 12 hours at room temperature

Adopted from https://dx.doi.org/10.15585/mmwr.mm6946a6
Production

**Vaccine Credibility**  (Craven, 2020)

- Manufacturer’s credibility
  - Pfizer
  - Moderna
  - Johnson and Johnson

- Manufacturing source

**Production Logistics**

- Previous vaccination allergy considerations
  - Egg protein not in COVID-19 vaccines (Graham, 2020)

- Number of doses required (Grady, 2020)
  - Pfizer: 57 day period between 1 and 2 dose

- Strength
  - Example flu vaccine has commercial dose and higher-dose for 65+ year old pts

- Availability (Grady, 2020)
  - Pfizer says 6.4 million in first distribution, up to 1.3 billion in 2021
  - Moderna: 500 million - 1 billion in 2021
Lack of education/misinformation/fake news

Biden COVID Response Committee, White House Press Committee, FDA, CDC, WHO WebMD, Mayo Clinic, Dr. Fauci, Mainstream media outlets, Public broadcasting networks, Influencers, Celebrities, Health Personalities (Dr. Oz), Talk Show Personalities, All Healthcare Personnel

Preliminary analysis, design, costing, logistics, tactics

Announce to Public, media, hearings, ads

Good reaction

Bad reaction

Good > Bad?

Yes

No

Proceed to execution

Adjust arguments, tactics and educate public
Infection & Death in Healthcare Workers
Morbidity & Mortality Report
Among Health Care Personnel (HCP)

**Nationally** (Hughes et al., 2020)

Cases
- 100,570 health care personnel (HCP) with COVID-19 reported to the CDC (February 12-July 16, 2020)

Demographics
- Median Age = 41 y/o
- Female = 79%
- Aged 16-44 years = 57%
- Not hospitalized = 92%

Deaths
- 641 deaths among 100,570 HCP nationally (0.6%)

Comorbidities
- 17,838 (44%) had at least 1 underlying medical condition
  - Cardiovascular Disease (18%)
  - Chronic Lung Disease (16%)
  - Diabetes Mellitus (13%)

**Locally - LA County** (Los Angeles County Department of Public Health, 2020)

Cases
- 19,748 HCP with COVID-19 reported as of 11/24

Demographics
- See table (non reported gender, age and race were not included)

Deaths
- 110 deaths among 19,748 HCP (0.56%)

**COVID-19 Total Fatal and Nonfatal Cases in Various Populations in LA County**
(as of 11/24/2020)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total No. Cases (#)</th>
<th>Alive (#)</th>
<th>Deceased (#)</th>
<th>Deceased per Pop Total Cases per Pop (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5,763</td>
<td>5,700</td>
<td>63</td>
<td>1.09</td>
</tr>
<tr>
<td>Female</td>
<td>13,415</td>
<td>13,368</td>
<td>47</td>
<td>0.35</td>
</tr>
<tr>
<td>&gt;65 years old</td>
<td>702</td>
<td>666</td>
<td>36</td>
<td>5.13</td>
</tr>
<tr>
<td>&lt;65 years old</td>
<td>18,959</td>
<td>18,885</td>
<td>74</td>
<td>0.39</td>
</tr>
<tr>
<td>Asian</td>
<td>2,794</td>
<td>2,754</td>
<td>40</td>
<td>1.43</td>
</tr>
<tr>
<td>Black</td>
<td>1,322</td>
<td>1,314</td>
<td>8</td>
<td>0.61</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>10,051</td>
<td>10,001</td>
<td>50</td>
<td>0.5</td>
</tr>
<tr>
<td>White</td>
<td>2,189</td>
<td>2,181</td>
<td>8</td>
<td>0.37</td>
</tr>
<tr>
<td>1+ comorbidities</td>
<td>Not Reported</td>
<td>Not Reported</td>
<td>92</td>
<td>Not Reported</td>
</tr>
<tr>
<td>No comorbidities</td>
<td>Not Reported</td>
<td>Not Reported</td>
<td>18</td>
<td>Not Reported</td>
</tr>
</tbody>
</table>

Table rendered by Hannah Christensen-Levy using data from Los Angeles County Department of Public Health, 2020
Death & Infections Among HCP

Weighted Percentage of Personnel Types
(among reported HCP w/ COVID-19 associated hospitalizations March 1 - May 31 in 13 states)

Adopted from https://www.cdc.gov/mmwr/volumes/69/wr/mm6943e3.htm
COVID-19 & Comorbidities
Comorbidities are defined as the simultaneous presence of two or more diseases or medical conditions in a single patient. Individuals with Comorbidities are at higher risk of contracting COVID and experiencing severe symptoms with fatal outcomes.
Common Comorbidities and Mortality

1. Elderly (long-term care)
2. Cancer
3. Chronic Kidney Disease
4. Hypertension
5. Obesity
6. Chronic Lung Disease
7. Diabetes
8. Cardiovascular Disease

(Sanyaolu et al, 2020)
Underlying Medical Conditions in COVID-19 Confirmed Hospitalized Cases (March 1 - 30, 2020)

- Hypertension: 49.70%
- Obesity: 48.30%
- Chronic Lung Disease: 34.60%
- Diabetes Mellitus: 28.30%
- Cardiovascular disease: 27.80%


- Hypertension: 15.80%
- Cardiovascular and Cerebrovascular: 11.70%
- Diabetes: 9.40%
- Coexisting Infections: 1.50%
- Malignancy: 1.50%
- Respiratory Illnesses: 1.40%
- Renal Disorders: 0.80%
- Immunodeficiencies: 0.01%

Leading Comorbidities Among COVID-19 deaths in NY, USA

- Hypertension: 55.40%
- Diabetes: 37.30%
- Hyperlipidemia: 18.50%
- Coronary Artery Disease: 12.40%
- Renal Disease: 11%
- Dementia: 9.10%
- COPD: 8.30%
- Cancer: 8.10%
- Atrial Fibrillation: 7.10%
- Heart Failure: 7.10%

Graphs adopted from Sanyaolu et al, 2020
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- Cancer: 8.10%
- Atrial Fibrillation: 7.10%
- Heart Failure: 7.10%

Graphs adopted from Sanyaolu et al, 2020
Effects of COVID-19 on Different Populations
Disparate Effect of COVID-19: Males vs. Females

Combination of Biological, Behavioral, & Psychosocial Factors

**Biological**
- Innate & Adaptive Immune Response Differences

**Behavioral & Psychosocial**
- Perceived Severity
- High-Risk Behaviors
- Adherence to Safety Guidelines
- Occupational Risk

Adapted from https://www.brookings.edu/blog/up-front/2020/05/15/covid-19-much-more-fatal-for-men-especially-taking-age-into-account/
Healthcare Access & Utilization
  - **Barriers to Care:** Transportation, Child Care, Language, & Cultural Differences
  - **Underutilization:** Uninsured & Community Distrust

Occupation & Education
  - Disproportionately Essential Workers
  - Limited Sick Days & Paid Leave
  - Affordability of Proper Safety Procedures
  - In-person vs. Online vs. Hybrid Schooling

Housing
  - Multi-generational Households
  - High Number of Evictions
  - Limited Affordable Housing Options

Disproportionately Incarcerated
  - Communal Living
  - Limited Control of Surroundings

---

### Disparate Effect of COVID-19: Minorities

<table>
<thead>
<tr>
<th>Rate ratios compared to White, Non-Hispanic Persons</th>
<th>American Indian or Alaska Native, Non-Hispanic persons</th>
<th>Asian, Non-Hispanic persons</th>
<th>Black or African American, Non-Hispanic persons</th>
<th>Hispanic or Latino persons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases</strong>(^1)</td>
<td>2.8x higher</td>
<td>1.1x higher</td>
<td>2.6x higher</td>
<td>2.8x higher</td>
</tr>
<tr>
<td><strong>Hospitalization</strong>(^2)</td>
<td>5.3x higher</td>
<td>1.3x higher</td>
<td>4.7x higher</td>
<td>4.6x higher</td>
</tr>
<tr>
<td><strong>Death</strong>(^3)</td>
<td>1.4x higher</td>
<td>No Increase</td>
<td>2.1x higher</td>
<td>1.1x higher</td>
</tr>
</tbody>
</table>

Disparate Effect of COVID-19: Age

8 out of 10 COVID-19 Deaths Reported Are From Adults 65+ yrs.

**Children & Teens**
- Mostly Asymptomatic
- Underlying Conditions
- Can Contract & Spread the Virus

**Young & Middle Aged Adults**
- More Likely to Live with Long-Term Effects
- Future Effect on Healthcare System

**Older Adults**
- Higher Risk for Having Comorbidities
- Decreased Resilience of Immune System

---

**Rate ratios compared to 18–29 year olds**

<table>
<thead>
<tr>
<th></th>
<th>Hospitalization¹</th>
<th>Death²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 years</td>
<td>4x lower</td>
<td>9x lower</td>
</tr>
<tr>
<td>5-17 years</td>
<td>9x lower</td>
<td>16x lower</td>
</tr>
<tr>
<td>18-29 years</td>
<td>Comparison Group</td>
<td>Comparison Group</td>
</tr>
<tr>
<td>30-39 years</td>
<td>2x higher</td>
<td>4x higher</td>
</tr>
<tr>
<td>40-49 years</td>
<td>3x higher</td>
<td>10x higher</td>
</tr>
<tr>
<td>50-64 years</td>
<td>4x higher</td>
<td>30x higher</td>
</tr>
<tr>
<td>65-74 years</td>
<td>5x higher</td>
<td>90x higher</td>
</tr>
<tr>
<td>75-84 years</td>
<td>8x higher</td>
<td>220x higher</td>
</tr>
<tr>
<td>85+ years</td>
<td>13x higher</td>
<td>630x higher</td>
</tr>
</tbody>
</table>

Disparate Effects on the Homeless

- **Pre-existing health conditions & illnesses** (Culhane, Treglia, Steif, Kuhn, & Byrne, 2020)
  - Chronic conditions
  - Behavioral health conditions
  - Infectious illnesses
  - Acute illnesses
- **Age distribution shifting upwards** (Culhane et. al, 2020)
  - In New York City, Los Angeles County, and Boston modal age for the homeless is 50-55 years
- **Impact of exposure to harsh environment**
  - Risk of accelerated age-related decline: dehydration, hygiene, poor sanitation, violence, etc.
- **Difficulties following prevention measures**
  - Lack of access to resources to maintain hygiene and tend to their health
  - Unsheltered/communal living

Adapted from: https://www.washingtonpost.com/business/2020/03/15/fears-mount-about-impact-coronavirus-homeless/
Disparate Effects on the Homeless

- Exact number of cases and deaths unknown for this population due to insufficient data
  - Estimates based on factors from previous studies:
    - 40% of the homeless population will be infected at any given time during a peak outbreak
    - 4.3% could require hospitalization (range 2.4%-10.3%)
    - Critical care needs could range from 0.6%-4.2%
    - Potential fatality rates could range from 0.3%-1.9%
      - Data skewed towards higher end due to limited access to healthcare and already high fatality rate

How do these estimates compare to those infected among the general population?

- Homeless will be twice as likely to be hospitalized
- Homeless will be 2 to 4 times as likely to require critical care
- Homeless will be 2 to 3 times as likely to die

(Culhane et. al, 2020)
15,600 nursing homes and 1.3 million residents in the U.S. ("COVID-19 Nursing Home Data", 2020)

Residents are a high-risk population:
  ○ 294,438 confirmed cases
  ○ 65,446 total deaths
    ■ ¼ of total known deaths ("CDC COVID Data Tracker", 2020)

Factors that make this population susceptible to infection:
  ○ Advanced age
    ■ Frailty, physical and cognitive impairment
  ○ Communal living conditions
  ○ Pre-existing chronic health conditions
    ■ 62% of Americans over the age of 65 have more than one chronic condition (Jaul & Barron, 2017)
Disparate Effects on Nursing Homes

Difficulties with preventing and mitigating outbreaks: PPE and staff shortages

- Study: Data collected on the 15,035 nursing homes that submitted data to the CMS COVID-19 Nursing Home database (McGarry, Grabowski & Barnett, 2020)

Study Period 1: May 18-June 14, 2020
- 20.7% reported having a severe PPE shortage with one week or less of supply
  - Most common types of shortages: N95 respirators (13.4%) and gowns (12.6%)
- 20.8% of total homes reported a staff shortage

Study Period 2: June 24-July 19, 2020
- 19.1% reported a PPE shortage and 21.9% reported a staff shortage
  - Most common types of PPE shortages: N95 respirators (14.4%) and gowns (10.9%)

Overall, facilities that were more likely to report shortages had higher rates of COVID-19 cases among residents and staff, serve a higher proportion of Medicaid patients, and have a lower quality rating (McGarry, Grabowski & Barnett, 2020)
Disparate Effects on Nursing Homes

Difficulties with preventing and mitigating outbreaks: Inadequate infection prevention and control protocols

U.S. GAO Analysis of CMS data
● From 2013 through 2017:
  ○ 82% of all surveyed homes had an infection prevention and control deficiency cited in 1 or more years
  ○ In each individual year, 39-41% of the surveyed homes had this deficiency
● In 2018 and 2019, about 40% of surveyed homes had this deficiency each year

CMS Report on results from targeted infection and prevention and control surveys and complaint/facility-reported incidents:
● Initial surveys for the week of March 30, 2020:
  ○ 36% of homes inspected did not follow proper hand washing guidelines and 25% failed to demonstrate proper use of PPE
  ○ Out of 15,276 surveys completed since March 4, more than 180 immediate jeopardy level deficiencies were found, which is 3x the rate of those found in 2019

(Infection Control Deficiencies Were Widespread and Persistent in Nursing Homes Prior to COVID-19 Pandemic | GAO*, 2020)

(CMS Announces Resumption of Routine Inspections of All Provider and Suppliers, Issues Updated Enforcement Guidance to States, and Posts Toolkit to Assist Nursing Homes | CMS*, 2020)
As coronavirus spread worsens, calls and texts for help spike

The federal Disaster Distress Helpline offers counseling and emotional support to people after manmade or natural disasters. Calls and texts to the line (shown by week) surged after COVID-19 was declared a national emergency.

Source: Substance Abuse and Mental Health Services Administration, Vibrant Emotional Health | Credit: Center for Public Integrity, Columbia Journalism Investigations

Adapted from: https://publicintegrity.org/health/coronavirus-and-inequality/coronavirus-calls-texts-mental-health-hotlines-are-surgeing/
“The Silent Pandemic” - Mental Health Effects

- Increased fear and anxiety
- Grief
- Job loss and economic insecurity
- Isolation and frustration
- Uncertainty and confusion
- Working from home and learning from home
- Vulnerabilities
  - Pre-existing MH conditions
  - Older adults
  - Children and adolescents
  - Mothers with school-aged children
  - Essential workers


(McCarthy & Richter, 2020)
Increased Symptoms of Anxiety & Depression During Pandemic

Adopted from: https://www.advisory.com/daily-briefing/2020/08/14/covid-mental-health

(Czeisler et al. 2020)
Economic Stress & Mental Health

Compared to people in other countries, Americans who faced economic problems are the ones who most often face mental health problems.

Percent of adults who reported experiencing stress, anxiety, and/or great sadness that was difficult to cope with alone*:

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>50%</td>
</tr>
<tr>
<td>Canada</td>
<td>50%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>39%</td>
</tr>
<tr>
<td>U.K.</td>
<td>53%</td>
</tr>
<tr>
<td>U.S.</td>
<td>56%</td>
</tr>
</tbody>
</table>

* Among respondents who reported being unable to pay for basic necessities, using up all or most of savings, or borrowing money because of coronavirus pandemic. Notes: Mental health questions not asked in Germany. Economic consequence questions not asked in Norway. Data not shown for France, Netherlands, or Sweden because sample sizes were too small (n<100) to ensure reliable estimates. Differences between the U.S. and New Zealand were statistically significant at the p<0.05 level.

Source: Reginald D. Williams II et al., Do Americans Face Greater Mental Health and Economic Consequences from COVID-19? Comparing the U.S. with Other High-Income Countries (Commonwealth Fund, August 2020).
U.S. suicide rates increased 33% in 20 years while global rates have declined.

1% increase in unemployment correlates to 1.6% increase in suicide rate.

Suicide rate jumped 13% during Great Recession (2008) translating to 46,000 lives.
Suicidal Ideation Year Comparison

LA help hotline (Didi Hirsch)

- Comparing Feb to March, 2020
- 22 calls compared to 1,800 calls
- = 8,000% increase

Adopted from: https://www.advisory.com/daily-briefing/2020/08/14/covid-mental-health

(Czeisler et al. 2020)
("Calls to suicide," 2020)
50% of US population will experience MH dx at some point in their lives
  - Less than half receive tx

WHO estimates $1 trillion cost in lost productivity annually (anxiety and depression alone)

MH is the leading cause of “disability adjusted life years”
  - 37% healthy years lost

Mental Health Fallout from COVID-19: Healthcare workers

- Mental Health Crisis wrought on by the pandemic.
  - Ongoing trauma:
    - Chronic period of elevated stress
      - High profile suicides by physicians and EMTs exacerbated
      - “Adrenaline Dump”
        - Emotions become raw: distress (20 -70%), exhaustion, insomnia, anxiety (28 -45%), grief, depression (30 -70%), burnout (Wong et al, 2020; Nelson & Kaminsky, 2020)
        - The feeling of betrayal by leaders, unprepared, unsupported, unprotected. Powerlessness and a sense of failure at not being able to save lives.
    - Survey - 61% of 1200 nurses from 400 hospitals are planning to quit their jobs or profession altogether ("Masson: Beckers Hospital Review", 2020).
Need for Strong Government Coordination
The Need for Strong Coordinating Role of The Central Government

"More people may die if we don’t coordinate" - Joe Biden (Bradner, 2020)

Biden Administration’s Plan

- Wide availability of free testing
- Elimination of all cost barriers to preventive care & treatment for COVID-19
- Development of a vaccine
- Deployment and operation of necessary supplies, personnel, and facilities
- Emergency paid leave for all those affected by the outbreak
- Offer all necessary help to workers, families, and small businesses

("Joe Biden for President: Official Campaign Website", n.d.)
The Need for Strong Coordinating Role of The Central Government

"It's not going to be easy. And it's going to take not only an adequate supply of the vaccine, but it's going to take perhaps one of the most important but challenging elements too, which is public trust,"

- Vivek Murthy, Biden's Coronavirus Advisory Board Chair  (Schwartz, 2020)

- The Biden Plan calls for:
  - **Restoring trust, credibility, and common purpose.**
  - Mounting an effective national emergency response that saves lives, protects frontline workers, and minimizes the spread of COVID-19
  - Pursuing decisive economic measures to help hard-hit workers, families, and small businesses and to stabilize the American economy.
  - Rallying the world to confront this crisis while laying the foundation for the future.

("Joe Biden for President: Official Campaign Website", n.d.)
COVID-19 Transition Advisory Board

Co-chairs:
- Vivek Murthy
  - Former Surgeon General
- David Kessler
  - Former FDA Commissioner
- Marcella Nunez-Smith
  - Associate Dean for Health Equity Research at Yale School of Medicine

Advisors:
- Rebecca Katz
  - Dir. of Center for Global Health Science and Security at Georgetown Univ. Medical Center
- Beth Cameron
  - Dir. of Global Health Security & Biodefense on the White House National Security Council
- Rick Bright
  - Former Chief of the Biomedical Advanced Research & Development Authority
- Atul Gawande
  - Former HHS Official under Clinton Administration
  - Surgeon at Brigham & Women’s Hospital
  - Professor at Harvard Medical School
- Luciana Borio
  - FDA’s Acting Chief Scientist
  - National Security Council under Trump Administration
- Eric Goosby
  - Developed HIV/AIDS policy under Clinton & Obama Administrations
  - Global AIDS Coordinator under Obama Administration
  - Professor of Medicine at UCSF School of Medicine
- Robert Rodriguez
  - Emergency Physician & Professor of Emergency Medicine at UCSF School of Medicine
- Loyce Pace
  - President & Executive Director of the Global Health Council
- Ezekiel Emanuel
  - Chair of the Department of Medical Ethics & Health Policy at the Univ. of PA
  - White House Aide under Obama Administration
- Michael T. Osterholm
  - Director of the Center for Infectious Disease Research & Policy at the Univ. of MN
- Celine R. Gounder
  - Clinical Assistant Professor of Medicine & Infectious Diseases at NYU’s Grossman School of Medicine
- Julie Morita
  - Executive V.P. of Robert Wood Johnson Foundation

(Abutaleb & McGinley, 2020)
(Diamond, 2020)
The Role of WHO, CDC & FDA
The Role of the WHO

- Identifying, mitigating and managing risks to prevent emergencies
- Support development of tools necessary during outbreaks
- Detect and respond to acute health emergencies
- Support delivery of essential health services in fragile settings

“WHO's primary role is to direct international health within the United Nations' system and to lead partners in global health responses” (WHO, 2020)
The Role of the WHO

Dec. 31, 2019
China alerts World Health Organization (WHO) to several cases of pneumonia with no known cause in Wuhan. The disease goes on to be named COVID-19.

Jan. 7
WHO officials announce they have identified a new virus named SARS-CoV-2 that causes COVID-19. It belongs to the coronavirus family, which includes viruses that cause SARS, MERS and the common cold.

Jan. 11
China announces the first death linked to COVID-19.

Jan. 13
WHO reports the first case outside of China in Thailand.

Feb. 26
National Institutes of Health (NIH) begin the first clinical trial in the U.S. for a potential COVID-19 treatment, remdesivir, an antiviral drug originally developed to treat Ebola.

Feb. 29
The FDA takes steps to expand novel coronavirus testing to hospital clinical microbiology laboratories.

Mar. 11
WHO declares COVID-19 a pandemic, with more than 100,000 cases and 4,000 deaths in 114 countries.

Apr. 2
Confirmed cases of COVID-19 top 1 million worldwide.

Apr. 10
Global deaths due to COVID-19 top 100,000.

Adapted from https://asm.org/Press-Releases/2020/COVID-19-Resources
The Role of the WHO

Globally, as of 10:00am CET, 12 November 2020, there have been 51,547,733 confirmed cases of COVID-19, including 1,275,979 deaths, reported to WHO.

The Role of the CDC

“CDC works 24/7 to protect America from health, safety and security threats, both foreign and in the U.S. Whether diseases start at home or abroad, are chronic or acute, curable or preventable, human error or deliberate attack, *CDC fights disease and supports communities and citizens to do the same*” (CDC, 2020)
The Role of the CDC

- Detecting and responding to new and emerging health threats
- Putting science and advanced technology into action to prevent disease
- Promoting healthy and safe behaviors, communities and environment
- Developing leaders and training the public health workforce, including disease detectives

(CDC, 2020)
CDC Resources: Daily Dashboard Cases/Testing

United States COVID-19 Cases and Deaths by State

Reported to the CDC since January 21, 2020

TOTAL CASES
11,465,722
+165,087 New Cases

CASES IN LAST 7 DAYS PER 100K
49.7

TOTAL DEATHS
249,670
+1,836 New Deaths

United States Laboratory Testing

TESTS REPORTED
171,122,505

POSITIVE TESTS
13,106,303

OVERALL % POSITIVE
8%

Adopted from https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days
EXPLORE HUMAN MOBILITY AND COVID-19 TRANSMISSION IN YOUR LOCAL AREA

SELECT STATE: USA
SELECT COUNTY: Los Angeles County
SELECT URBAN/RURAL COUNTY CLASSIFICATION: [All]
SELECT METRIC OF INTEREST: Seven Day Absolute Change in Incidence

Los Angeles County, USA

WORKPLACES: -36%
RETAIL AND RECREATION: -30%
TRANSIT STATIONS: -41%
% AT HOME: 34%
MOBILITY INDEX: 3.8

Adopted from https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days
CDC Resources: Case Breakdown

Cases by Age Group:
Data from 8,607,120 cases. Age group was available for 8,576,471 (99%) cases.

Cases by Race/Ethnicity:
Data from 8,607,120 cases. Race/Ethnicity was available for 4,531,348 (52%) cases.
The Role of the FDA

“Protect public health by assuring the safety, effectiveness, quality, and security of human and veterinary drugs, vaccines and other biological products, and medical devices” (FDA, 2020)
The Role of the FDA

Major focus areas of the FDA’s response including increasing the availability of

- Tests
- Ventilators
- Personal Protective Equipment (PPE)
- Other COVID-19 related products

Also, decreasing the amount of fraudulent COVID-19 products on the market

(FDA, 2020)
FDA Fast Facts

- 283 tests are authorized
  - 221 molecular tests
  - 56 antibody tests
  - 6 antigen tests

- Added more than 100 ventilators and other medical supplies

- Monitoring 350 trials of potential therapies for COVID-19
  - Approved Remdesivir on October 22nd 2020

- Identified 1127 fraudulent COVID-19 medical products

(FDA, 2020)
The Role of Experts & Fake News
Spread of Misinformation

- Fake news propagates widespread panic amongst the population, and COVID-19 saw with it a drastic increase in the amount of fake news coverage regarding the virus (Apuke & Omar, 2020)

- The main issue with fake news surrounding the virus is the confusion and misinformation it supplies the general public with (Tagliabue, Galassi & Mariani, 2020)
  - Caused a rush to purchase PPE → supply<demand → those who need it don’t get it
  - Fear of vaccine = less willing to receive it

- Misinformation breeds conspiracy theories, and in regards to COVID-19, many individuals downplayed the virus or even refused to believe it was real (Tagliabue et al., 2020)
  - This lead to increased risk of infection, as these individuals were less careful

Consequences of Fake News

- Fake news instills fear or lack of trust in a vaccine
  - Less people willing to receive it
- According to Fauci, > 50% of Americans need to be vaccinated
  - Considerable health challenge if this isn’t achieved
- Herd immunity: community protection against an illness
  - WHO states 65-75% vaccine coverage is needed to achieve this

(Lin, 2020) 
Global Medical Supply Stockpiles
Global Medical Supply Chain

- United States Deficiency of PPE in the pandemic (Herndon, 2020)
  - US has 1% of the masks needed to fight COVID-19
  - PPE is rationed in hospitals & medical clinics
  - Requires use of sub-par PPE in many instances

- Causes of the deficiency
  - Lack of domestic production (testing materials & PPE)
  - Ceasing/Slowed Trade
  - H1N1 epidemic (2009) depleted national PPE stores by 1 million - never replaced (OECD, 2020)

- Short Term Response
  - Manufacturers were asked to increase production by 40% to meet rising global demand (WHO, 2020)
    - 89 million masks/month
    - 76 million gloves/month
    - 1.6 eye protection/month

U.S. Medical Supply Chain Quick Successes (FEMA, 2020)

- US government contracted with 3 textile manufacturers to produce 88.6 million reusable isolation gowns
- Connected a US manufacturer with trade associations to partner & expand hand sanitizer production capacity
- Facilitated joint initiative between US medical manufacturer & retailer to provide 8.4 million isolation gowns to private market within 3 months
- Provide assistance to non-medical manufacturers which allowed retooling of existing facilities to create millions of masks
U.S. Medical Supply Chain Future Plans

- N95 production expected to exceed 1 billion in 2021 (Lopez, 2020)
- Supply Chain Task Force working to rapidly increase long-term supply of medical supplies & equipment (Department of Homeland Security, 2020)
  - Increase traditional medical supply manufacturing capabilities
    - Break down barriers
      - Government financial assistance
      - Regulatory assistance
      - Defense Production Act - front line orders filled before other orders
  - Explore opportunities within private sector to boost manufacturing by using non-traditional manufacturers
    - Encourage cross-sector collaboration
    - Foster relationships
Stockpiles

- Block exports and hoarding critical supplies (Newman, 2020)
- Lack of materials for critical supplies
  - Countries specialize in certain items
  - One product might rely on multiple countries for materials
  - “Just in Time” supply chains
- Russia, Turkey, and Germany restricted export of masks and respirators
  - Germany part of EU and should’ve exported supplies
  - No tariffs on critical supplies
  - Transparency on supplies
  - Stockpiles in certain regions for easy access
  - Address needs of countries at risk
Lessons Learned in the U.S.
Faith in the federal government must be restored among the U.S. population

- Trump firing “whistleblower”, Dr. Rick Bright from his administration (Greve, 2020)
- Decision to block USPS from delivering 5 masks to each household (650 million in total) (Miao, 2020)
- Only one stimulus check throughout the entire pandemic
- Reluctance to fully engage in all parts of the contact tracing process
  - “48% of U.S. adults say they would be comfortable or likely to engage with all three key steps – speaking, sharing and quarantining” (McClain & Rainie, 2020).
The Future of Telehealth in U.S. Healthcare

Telehealth services must be expanded

- “An estimated 41%-42% of U.S. adults reported having delayed or avoided seeking care during the pandemic because of concerns about COVID-19, including 12% who reported having avoided seeking urgent or emergency care.” (Koonin et al., 2020)
- There was a “154% increase in telehealth visits during the last week of March 2020, compared with the same period in 2019” (Koonin et al., 2020)

Continuing to uphold policy changes and regulatory waivers implemented during the pandemic, as well as improving accreditation, payment systems, and insurance coverage for these services.

Can improve accessibility to care, preserve PPE, minimize overburden on healthcare workers, mitigate outbreaks in future pandemics, etc.
Lessons for Localities

- Frontline assistance to their residents
  - Rent freezes
  - Providing shelter to the homeless
  - Outreach and educational programs (Alvarez, 2020)

- Conflict with the authority of state governments
  - Texas governor signed executive order preventing local authorities from implementing the requirement of face coverings in public (Wamsley, 2020)

Testing on College Campuses

- Colleges with more than 5,000 students (Nadworny & McMinn, 2020)
  - 25% utilizing randomized testing
  - Only 6% utilizing routine testing
  - Most only testing symptomatic people
- Testing is expensive and most colleges cannot afford it
  - University of Illinois: $10/test; up to $1 million a week (Nadworny et al., 2020)
- The University of Illinois was testing 10,000 to 15,000 saliva-based COVID tests a day (Nadworny, 2020)
- Chemist Martin Burke
- In under 2 weeks there were over 700 cases reported on campus (Nadworny, 2020)
- Mass testing allows these situations to be caught early and preventative measures can be made (Guglielmi, 2020)

Adopted from: https://www.nature.com/articles/d41586-020-02611-y
Testing on College Campuses

Majority Of Students In Hot Spots Are Not Receiving Regular Coronavirus Tests

Each square represents 1,000 full-time undergraduates who attend a college in a county with 25 or more average daily cases per 100,000 people and that is not primarily online (though some schools may be using a hybrid online/in-person schedule).

- Regularly tests students
- Random surveillance testing
- Only at-risk students
- No clear plan

Notes
Includes only ongoing coronavirus testing; excludes testing for students arriving on campus and pre-arrival testing.

Source: College Crisis Initiative at Davidson College
Credit: Swan McMinn/NPR

Adapted from https://www.npr.org/2020/10/06/919159473/even-in-covid-hot-spots-many-colleges-arent-aggressively-testing-students
Schools

- Nationwide, schools rapidly transitioned to online learning as quarantine began. Teachers and students were forced to adapt (Delgado, 2020).
- Several issues emerged immediately (Watkins, 2020):
  - Some families had no WiFi or compatible device access
  - Working parents/guardians had to ensure safe/stable space for their students
  - Teachers had to figure out how to teach content virtually
- Lessons learned from these issues (Garcia & Weiss, 2020):
  - The 3 R’s: Relief, Recovery, Rebuilding
  - Schools need a “rainy day” contingency plan, along with established federal support
  - The system must focus on nurturing the whole child, as well as supports mental health of the staff involved
For all businesses throughout COVID-19, the future seemed uncertain. But the issue with staying afloat came from lack of plan for uncertainty (Shelton, 2020).

Many businesses suffered financially from quarantine shut-down, but all established strategies to utilize in similar future events (“The COVID-19 lessons businesses must learn”, 2020):

- Plan for the unexpected
- Have a communications team in place
- Know your stakeholders and how to move around them if they fail
- Maintain technological intervention

We cannot predict the presence or absence of a new pandemic in the future.

How will businesses be impacted by another possible pandemic?

- Hopefully with these identified areas of concern, there will be more contingencies put in place by the businesses and their stakeholders.

Businesses → Adaptability
Elected officials do not always lead by example
  ○ Several have been caught failing to comply to the prevention and control measures that they enforce
    ■ California Governor Gavin Newsom (Melugin & Isheiwat, 2020)

The power of compassion, support, and community
  ○ Crowdfunding through platforms like GoFundMe (GoFundMe, 2020)
    ■ Between March 1 and August 31, over $625 million through over 9 million donations were raised to help those burdened by the pandemic
    ■ Over 150,000 fundraisers created for COVID-19-related relief
      ○ News story: Customer leaves $3,000 tip on a $7 tab at a restaurant in Cleveland that was days away from closing (The Associated Press, 2020)

It is never too late to start a hobby or learn a new skill
  ○ Pastime activities have helped individuals cope with the realities of the pandemic
The Next Pandemic
When Can We Expect the Next Pandemic?

- Not a question of if, but when
- Next pandemic always labeled “Disease X”
- Most likely transfer of new disease will be from animals
- Over the past three decades Scientist found more than 30 new bacteria and viruses capable of infecting humans (Chan & Salzman, 2020)
- Scientists speculate pandemics will become more frequent, if this happens, pandemics will not become sustainable
- The cost of pandemics are great, many lives are lost and the economy suffers (Chan & Salzman, 2020)

Adopted From: https://www.imperial.ac.uk/news/196496/coronavirus-pandemic-could-have-caused-40/
Predicted Triggers of the Next Pandemic

- Viral transfer from animal to human (Zoonotic Transfer)
  - Reason for 3 out of 4 infectious diseases (CDC, 2020)
  - Increasing threat as humans interact more with animals (Gavi, 2020)
  - Encroachment
  - Husbandry
  - Trade
- Human migration (Chan & Salzman, 2020)
  - Faster, easier travel
  - Increasing population
The Next Pandemic: Mitigation Strategies

One Health Commission: (Amuasi et al., 2020).

- A concept proposed by *The Lancet*
- Recognized and promoted by the UN, the G20, WHO, and many others
- Highlights the “synergistic benefit of closer cooperation between the human, animal, and environmental health sciences”
- Goal: To promote health within the environment shared by humans and animals
- Three major dimension:
  - Shared Environment
  - Safe Food & Food Systems
  - Shared Medicines and Interventions
The Next Pandemic: Mitigation Strategies

“Herd Immunity”:
- When enough people in a community gain immunity of a disease, it prevents the spread/outbreak of the disease.

Surveillance & Study Trends
- Understand specific human activities that may increase the risk of spillover
- Ongoing surveillance for emerging pathogens that pose a risk to community health
  - Looking out for human-animal interfaces, and develop systems to respond quickly.

U.S. Government & Trump Lies
Trump Lies

- **Earliest Misinformation: February 7, 2020** (Evanega, Lynas, Adams & Smolenyak, 2020)
- **37.9% Misinformative claims** (Evanega et al., 2020)
  - Only 16.4% were fact-checking coverage (Evanega et al., 2020)
- **Miracle cures**
  - 26.4% Appearance Frequency (Paz, 2020)
  - Hydroxychloroquine, Chloroquine, Disinfectant injection, warm weather, etc. (Rutledge, 2020)
- **Vaccine** (Paz, 2020)
  - March 2nd: Earliest implication of vaccine completion
  - May 8th: Claimed virus would dissipate without vaccine
    - Similar to SARS-COV
  - August 6th: Vaccine would be ready by Election Day
Misinformation Graphs

Figure 3: Coverage volume of different misinformation sub-topics in traditional and online media during the pandemic.

Figure 4: Misinformation media coverage of the “miracle cures” topic over time. (Note: headlines are illustrative to show topic peaks and are not necessarily the most prominent specific articles of the time.)
Other Conspiracies

- **Bill Gates** (Evanega et al. 2020)
  - Anti-Vaccination Movement
  - Warned of pandemic dangers

- **Dr. Fauci** (Evanega et al. 2020)
  - Instructed to not use masks early in pandemic
  - Accused of inflating deaths and conspiring with Democrats
  - #FireFauci

- **Wuhan Bioweapon** (Evanega et al. 2020)
  - Human population control
  - Manufactured in a lab

- **Deep State** (Evanega et al. 2020)
  - Trump is savior
  - Qannon Conspiracy

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Adapted from: https://www.nytimes.com/2020/02/14/us/antivaccination-coronavirus.html
Politician & Political Commentator Contributions

● **Blame China**
  ○ Travel ban on Chinese citizens and further sanctions against China (Peters, 2020)
  ○ Calling the virus “Kung Flu, China Virus, Chinese Flu” (Peters, 2020)
  ○ Speculation where virus originated from (Peters, 2020)

● **Downplay risks**
  ○ Bob Woodward interviews (Thorp, 2020)
  ○ Compare to less severe crises (automobile crashes, previous pandemics, wars, etc.) (Peters, 2020)

● **Play-Up Survivor Stories**
  ○ Trump survival story (Peters, 2020)
  ○ Fox News highlighting survival stories (Peters, 2020)

● **Blame Democrats/Radical Left**
  ○ Antifa/Radical Left agenda (Peters, 2020)
  ○ Virus will disappear Nov. 4th (Peters, 2020)
Political Issues: Trump Explained
Priorities of a Narcissist

“Catastrophic Neediness”

+ Authoritarian

= High sense of social dominance

  ● *Racism, denial of privilege, uniqueness*

= Perceive themselves as non-conforming and rebellious

= Being at the top of the pecking order over traditional values

  ● *Traditional conservative, Republican values mean little*

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DSM Criteria for Narcissism

*Grandiose sense of self*

*Lack of Empathy*

*Sense of Entitlement*

*Exploitive*

*Envious of Others*

*Arrogant Behaviors and Attitudes*

*Requires Excessive Validation and Admiration*

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(5th ed.; DSM-5; American Psychiatric Association, 2013)

Klein, 2017.
Trump’s Covid Strategy: “I’d rate it a 10.”

Priorities
- Financial Markets
  - “I didn’t want to create a panic.”
  - “Rattling” markets
  - Political “weather-vane”
  - Ignored warning signs
  - Pushed to re-open
- Media
  - Daily PR problem
  - “Consider each day as an episode in a television show.”
  - “State hand-off”
  - Swabs for favors

Characteristics
- Indecisive, quick to blame others
  - Leadership vacuum
  - Turf wars between individuals and government agencies
- Short-term focus ≠ long-term plan
  - Mixed messages
  - Denial and fabricating facts
- Distrust of career professionals
  - Discred Fauci
  - Contradict scientific recommendations: masking, social distancing
  - Pressure governors to not mandate masks

Cost
- No coordinated plan
  - National testing
  - Tracing
  - Isolation
  - Lack of supplies
- Cut policy efforts
  - USPS mask plan
- Prolonged pandemic
  - Infection
  - Death
- Outlier among peers

(Haberman & Weiland, 2020)
(Shear, Weiland, Haberman & Sanger, 2020)


https://www.cdc.gov/coronavirus/2019-ncov/covid-data-tracker/#cases_casesper100klast7days


https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days


https://www.bruegel.org/publications/covid-national-dataset/

http://www.cdc.gov/coronavirus/2019-ncov/covid-data/tracker/cases-casesper100klast7days


https://www.cdc.gov/coronavirus/2019-ncov/covid-data-tracker/#cases_casesper100klast7days

https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days


https://www.cdc.gov/coronavirus/2019-ncov/covid-data/tracker/cases-casesper100klast7days

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/tracker/cases-casesper100klast7days
Final References


