A Primer on COVID-19

The disease
Placing the disease in context
Information backing up present public health measures
Practical tips – beyond standard messages

To be updated periodically
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Updated 3/30/2020
University of Arizona
COVID-19

- Coronaviruses cause diseases in mammals and birds. Some cross species to humans causing zoonotic illness.
- In humans they cause respiratory disease. About a quarter of common colds are caused by Coronaviruses. More serious coronavirus diseases include SARS and MERS.

Why are novel coronaviruses so dangerous?

- Our bodies form antibodies to foreign invaders, such as bacteria or viruses.
- If we have antibodies from a previous exposure, then we can rapidly ramp up the production of those antibodies if we are infected by that same virus at a later date.
- COVID-19 is a severe respiratory illness caused by the virus named SARS-CoV2 *. It is a novel virus, which means that no one in the world has antibodies to it because no one has ever been infected by it before.
Facts about Covid-19

What we know at the moment
Subject to updates as the science progresses
COVID-19

**STATS**
- Confirmed: 127,863; Recovered: 68,310
- Deaths: 4,718; Fatality Rate: ~3.4%

**VIROLOGY**
- Betacoronovirus
- SARS-CoV2 (SARS-Like Receptor-Binding)

**EPI**
- Global (Pandemic), China, Italy, Iran, South Korea

**TRANSMISSION**
- Bat → Pangolin → #1
- #1 → Cough (Droplet) → Respiratory Tract → Binds

**INCUBATION**
- Cases vs Days
  - 2 5 14

**ILLESSEVERITY**
- Cases
  - Mild
  - Severe
  - Critical
  - Elderly at Risk
  - Hypoxia
  - Resp Failure
  - >50% Lung Involvement
  - Shock

**RECOVERY TIME**
- Mild Cases: ~2 wk
- Severe Cases: ~6 wk

**DIAGNOSIS**
- CT-Chest, ↑↑ Sensitivity:
  - GGO (1st Sign)
  - Consolidation
  - Crazy Paving
  - Prob: Effusion, Cavity, LAN
- PCR: Diagnostic, ↑↑ Sens

**SYMPTOMS**
- Fever (+/- Early), Fatigue
- Dry Cough, Dyspnea, Sputum (Minority)
- Anorexia, Myalgia
- Less Common: GI, Rhinorrhea, Headache

**TREATMENT**
- Supportive
- Social Distancing
- Remdesivir
- Chloroquine
Symptoms vary and mimic other common diseases until severe: Here is what we know from China

The symptoms of coronavirus disease [COVID-19]

The most common signs and symptoms of 55,924 laboratory confirmed cases of COVID-19.
Reported from China in the period up to February 22, 2020

- Fever: 87.9%
- Dry cough: 67.7%
- Fatigue: 38.1%
- Sputum production: 33.4%
- Shortness of breath: 18.6%
- Muscle pain or joint pain: 14.8%
- Sore throat: 13.9%
- Headache: 13.6%
- Chills: 11.4%
- Nausea or vomiting: 5%
- Nasal congestion: 4.8%
- Diarrhoea: 3.7%

Many of the most common symptoms are shared with those of the flu or cold. So it is also good to know which common symptoms of the flu or the common cold are not symptoms of COVID-19. COVID-19 infection seems to rarely cause a runny nose.

What are the symptoms and how does it affect my body?

Access information listed below (provide good summaries) in addition to CDC and WHO websites:


• Here’s what coronavirus does to the body: nationalgeographic.com/science/2020/02/here-is-what-coronavirus-does-to-the-body

• CDC: https://www.youtube.com/watch?v=I-Yd-XIwJg&feature=share&fbclid=IwAR1g8OJPSImsSmPGdzAe6G8CIRJjtlQgUcVujJzkbdfPE8PQ9502QTtRo4 (good knowledge and recommended practice summary)****
Signs of illness may precede actual symptoms
Pay attention to your senses

• Sudden loss of smell and taste have been documented in approximately 30% of confirmed cases before notable symptoms occurred
• Reported in South Korea, China, and Italy as well as UK and France

• Self isolate as soon as you notice this whether you have other symptoms or not
• Younger patients in particular may demonstrate only a loss of smell or taste, without demonstrating the more commonly recognized coronavirus symptoms of high fever and persistent coughs
Severity: distribution

The Majority of Infections are Mild
Seriousness of symptoms

- **MILD**
  - Like flu, stay at home
  - 80.9%

- **SEVERE**
  - Hospitalization
  - 13.8%

- **CRITICAL**
  - Intensive care
  - 4.7%

The Bulk of People Recover
Of total worldwide confirmed cases...

- **Currently ill**: 40%
- **Recovered**: 56.6%
- **Critical**: 3.5%

Note: This data is based on a study of 44,672 confirmed cases in Mainland China, sourced from China Center for Disease Control & Prevention, Statista.

Source: Johns Hopkins University
Who is affected most severely?

Mortality data

- Those > 65
- Those with chronic illness like heart disease, diabetes, lung disease
- Smokers

Note: COVID-19 infections are 10 times greater than the "flu" even in the least affected group of individuals > 10 and < 40.

Source: Centers for Disease Control and Prevention (CDC), Chinese Center for Disease Control and Prevention
Those Aged 60+ are Most At Risk

% infectees who die

Note: This data comes from the first wave of infections in Wuhan, China, where lung health is poor and smoking rates are high. Coronavirus attacks the lungs.

Especially Those with Existing Conditions

% with other serious ailments who die

- Cardiovascular disease: 10.5%
- Diabetes: 7.3%
- Chronic respiratory disease: 6.3%
- Abnormally high blood pressure: 6%
- Cancer: 5.6%
- No existing conditions: 0.9%
What about those aged 20-64 experiencing COVID-19

• 20% of COVID-19 deaths in the USA (first 4000 cases) as of March 16 were aged 20-64 years
• 20% of those hospitalized were aged 20-44 years.
• Compared with the under-19 year old group, patients aged 20-44 years appeared to be at higher risk for hospitalization and ICU admission
How COVID-19 Affects Different U.S. Age Groups

Hospitalization, ICU admission and fatality rates for reported U.S. COVID-19 cases by age group*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Hospitalization</th>
<th>ICU admission</th>
<th>Case fatality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19</td>
<td>1.6%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>20-44</td>
<td>2.0%</td>
<td>0.1%</td>
<td>14.3%</td>
</tr>
<tr>
<td>45-54</td>
<td>5.4%</td>
<td>0.5%</td>
<td>21.2%</td>
</tr>
<tr>
<td>55-64</td>
<td>4.7%</td>
<td>1.4%</td>
<td>20.5%</td>
</tr>
<tr>
<td>65-74</td>
<td>8.1%</td>
<td>2.7%</td>
<td>28.6%</td>
</tr>
<tr>
<td>75-84</td>
<td>10.5%</td>
<td>4.3%</td>
<td>30.5%</td>
</tr>
<tr>
<td>&gt;85</td>
<td>6.3%</td>
<td>10.4%</td>
<td>31.3%</td>
</tr>
</tbody>
</table>

* Based on 2,449 COVID-19 patients with a known age. (February 12–March 16, 2020).
Source: Centers for Disease Control and Prevention
Children do not seem to be dying, but can they get very sick

• Children are just as likely as adults to get infected*

• In general, children experiencing all coronaviruses do not become as ill as adults
  • During the previous outbreaks of Severe Acute Respiratory Syndrome (SARS) in HK and Middle East Respiratory Syndrome (MERS) in South Korean, very few pediatric patients were reported. Despite a high mortality rate of SARS and MERS in the adults, there were no fatalities in the pediatric patients. Children appeared to have a milder form of the disease caused by the coronaviruses, including Covid-19 (SARS-CoV-2)**

• There is a range of severity and symptoms of COVID-19 in children***
  • Infected children may be asymptomatic or have fever, dry cough and fatigue; some patients experience gastrointestinal symptoms, including abdominal discomfort, nausea, vomiting, abdominal pain and diarrhea. Most infected children have mild clinical manifestations and usually have a good prognosis. Usually they recover within 1–2 weeks after the onset of the disease.

• The idea that this is no big thing for youth is misguided – children can still experience pneumonia and be sick for a few weeks
I have heard that the mortality rate for men is greater than women

• Data from China show that among the tens of thousands of people infected there, 2.8 percent of men died from the virus compared with 1.7 percent of women. The median age of the fatal cases among women was five years older than among men*

• The mortality rate is twice as high among men in Italy as it is among women in every age group **

Why?

• Could be many factors
  • Differences in rates of smoking by gender
  • Differences in rates of high blood pressure and heart disease by gender
  • Differences in the way that male and female immune systems respond, and/or as a result of hormonal changes***
    • Differences exist: For example, women tend to have more autoimmune disorders than men
    • Gender differences in the microbiota
  • Differences in medication use
What explains the huge differences in mortality in countries like Italy and S. Korea

Demographics in part explain some of the difference

• The population of Italy differs from much of the world. According to a UN report in 2015, 28.6% of the Italian population was 60 years old or older. By comparison, in South Korea, 18.5% of the population is at least 60 years of age, ranking 53rd globally.

• In Italy, 90% of the more than 1,000 deaths occurred in those 70 or older.

• By contrast, the outbreak in South Korea has occurred among much younger people. There, only 20% of cases have been diagnosed in those 60 years old and up. The largest affected group is those in their 20s, who account for almost 30% of all cases.

• We need to consider testing policy as well when it comes to catching mild cases in need of self quarantine. In South Korea, the rate of testing has been quite high (3,692 tests per million people as of March 8), Italy 826 people per million.

➢ Note: Both countries have excellent health care systems
How serious is COVID-19 compared to the “flu”

<table>
<thead>
<tr>
<th></th>
<th>FLU</th>
<th>COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RO number</strong></td>
<td>1.3</td>
<td>2 - 2.5 [Bottom of the range]</td>
</tr>
<tr>
<td>Estimate of how many people will be infected by an average individual with the disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Incubation time</strong></td>
<td>1-4</td>
<td>1-14 [Top of the range]</td>
</tr>
<tr>
<td>The time from exposure to first symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hospitalization rate</strong></td>
<td>2%</td>
<td>19%</td>
</tr>
<tr>
<td>Average percentage for total cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Case fatality rate</strong></td>
<td>.1% or less</td>
<td>1-3.4%</td>
</tr>
<tr>
<td>Percentage of reported deaths among total cases</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: CDC, WHO, NCBI
New coronavirus

Most estimates put the fatality rate below 3%, and the number of transmissions between 2 and 4.

Note: Average case-fatality rates and transmission numbers are shown. Estimates of case-fatality rates can vary, and numbers for the new coronavirus are preliminary estimates.
How does it spread?

• This virus is spread in large droplets by coughing and sneezing.
• You are at risk if a person coughing is close to you as droplets descend to surfaces; that is why it’s best to remain 6 feet or more from others.
• All the surfaces where droplets land are infectious for 24 hours to a week depending on what the surface is made out of:
  • A recent study finds that the virus can survive on hard surfaces such as plastic and stainless steel for up to 72 hours and on cardboard for up to 24 hours.
CORONAVIRUS LIFESPAN ON SURFACES

- AIRBORNE: 30 MINUTES TO 3 HOURS
- CARDBOARD: 24 HOURS
- STAINLESS STEEL: 2 DAYS
- PLASTIC: 3 DAYS
How does it spread?

Protect your nose and mouth

• The virus infects you through your nose or mouth via your hands or an infected cough or sneeze onto or into your nose or mouth

• This virus only has cell receptors for lung cells (it only infects your lungs)
Can the virus remains in the air in aerosol form for some time?

• The primary point of contact appears to be the virus on surfaces
  • At present the biggest concern is the surfaces you touch
• However, some research suggests that the virus may remain in the air for some time
  • For minutes up to three hours, depending on environmental conditions
  • A Chinese, 48-seat bus study found that the virus infected people in a closed environment with air-conditioning up to 15 feet, suggesting that in some environments the transmission distance of this coronavirus exceeds the commonly recognized safe distance of 6 feet.
• Is it wise to wear a mask if riding on a bus? In China, scientists think so.
Asymptomatic & mildly symptomatic in relation to disease transmission

• Several studies have shown that people without symptoms are causing substantial amounts of infection.
• Chinese data suggests that the number of “silent carriers” could be as high as one-third of those who test positive
  • More than 43,000 people in China had tested positive without immediate symptoms by the end of February and were quarantined
• Of the 135 people in the Tianjin cluster, between 62% and 77% contracted the infection from someone who was pre-symptomatic.
• Between 48% and 66% of the 91 people in the Singapore cluster contracted the infection from someone who was pre-symptomatic.
• Iceland is attempting to test its entire small population and has the means to do so. It has reported that so far 50% of all cases identified are asymptomatic.
• Asymptomatic cases were found on the Diamond Princess cruise ship: 322 of 621 people tested positive but showed no symptoms
• It appears that a Massachusetts coronavirus cluster with at least 82 cases was started by people who were not yet showing symptoms
  • Hence the importance of social distancing
• The > 60 group must distance themselves from youth. Someone you know, even your grandchild may be asymptomatic.
• Engage in safe forms of social interaction with loved ones such as sociality through social media and the phone.
Incubation period

• 5.1 days appears to be the median amount of time but the range is much larger.

• Existing data suggests that about 97.5 percent of people who develop symptoms of COVID-19 infection will do so within 11.5 days of exposure.

• The researchers estimate that for every 10,000 individuals quarantined for 14 days, only about 101 would develop symptoms after being released from quarantine.**

• Chinese health officials who previously estimated that the incubation period for the virus ranged from one to 14 days, now suggest it could be as long as 24 days.***
When are you most contagious if you have a mild to moderate illness

• In Covid-19 peak shedding occurs from the upper airways early on in the infection which makes for a virus much harder to contain than another coronavirus like SARS (where peak shedding occurs deep in the lungs) *

• At peak shedding, people with Covid-19 are emitting more than 1,000 times more virus than was emitted during peak shedding of SARS infection

• This most likely explains the rapid spread of the virus. The SARS outbreak was contained after about 8,000 cases; the global count of confirmed Covid-19 cases has already topped 110,000.
How many people will a sick person infect? Estimates for COVID-19 will no doubt be subject to revision over time.
How long do people shed the virus and how does this relate to being contagious?

- Presence of the virus does not necessarily indicate level of contagion

What do we know so far?

- Wuhan data: Median duration of viral shedding was 20.0 days (IQR 17.0–24.0) in survivors.
  - The longest observed duration of viral shedding in survivors was 37 days

- A small but important German study found that people with mild infections can still test positive by throat swabs for days and even weeks after their illness.*

- However, those only mildly sick are most likely not still infectious by about 10 days after they start to experience symptoms, and moderately sick by days 10-11.
  - The scientists could not grow viruses from throat swabs or sputum specimens after day 8 of illness from people who had mild infection.
  - The researchers found very high levels of virus emitted from the throat of patients from the earliest point in their illness—when people are generally still going about their daily routines. Viral shedding dropped after day 5 in all but two of the patients, who had more serious illness.
Re-infection? We do not know, but so far it is rare

- Reports of patients testing positive for the coronavirus a second time have come out of China, Japan and South Korea.
- But some health officials argue with these conclusions, saying they may be the result of relapses or errors in testing.
- Animal studies (*rhesus macaques*) have not documented cases of reinfection.
- Dr. Anthony Fauci, thinks it’s likely that someone who gets infected once is actually immune.
- However, much remains unknown about the virus.
- Reports of re-infection have health experts worried that the illness could remain dormant after an apparent recovery.
- “Once you have the infection, it could remain dormant with minimal symptoms,” Philip Tierno Jr., professor of microbiology and pathology at New York University, told Reuters. “And then you can get an exacerbation if it finds its way into the lungs.”
How fast does this virus escalate?

Depends on steps taken during trajectory of illness
Exponential spread: For every two-six days that we delay engaging in social distancing, the number of infections double

Official line:

• Every person with the COVID-19 virus infects approximately two to four people.
• The infection rate doubles every two to six days (there is a range depending on what policies/programs different countries are implementing).
• That means that if 50,000 people have the virus today, then in 6 days, 100,000 people will have it.
• In another 12 days it’s 400,000 and less than two weeks later it’s over a million people.
• We have 330 million people in the US. The experts expect that 40-70% of people will be infected.
Country by country: how coronavirus case trajectories compare
Cumulative number of confirmed cases, by number of days since 100th case

FT graphic: John Burn-Murdoch / @burnmurdoch
Source: FT analysis of Johns Hopkins University, CSSE, Worldometers; FT research. Data updated March 29, 19:00 GMT © FT
Exponential spread

Total number of confirmed U.S. coronavirus cases at each Tuesday: January to March 10

Jan. 14 — 0
Jan. 21 — 1
Jan. 28 — 5
Feb. 4 — 11
Feb. 11 — 14
Feb. 18 — 25
Feb. 25 — 59
Mar. 3 — 125
Mar. 10 — 1,004
Coronavirus deaths in Italy, Spain, the UK and US are increasing more rapidly than they did in China

Cumulative number of deaths, by number of days since 10th death

Nationwide lockdowns: 🌟

FT graphic: John Burn-Murdoch / @jburnmurdoch
Source: FT analysis of Johns Hopkins University, CSSE; Worldometers; FT research. Data updated March 29, 19:00 GMT © FT
Where are we in the disease trajectory?

Based on the trajectory of other types of pandemic influenza
PANDEMIC INFLUENZA PHASES (2009)

**PHASES 1-3**
- Predominantly animal infections; few human infections

**PHASE 4**
- Sustained human-to-human transmission

**PHASES 5-6 / PANDEMIC**
- Widespread human infection

**POST PEAK**
- Possibility of recurrent events

**POST PANDEMIC**
- Disease activity at seasonal levels
Coronavirus: Upward Trajectory or Flattened Curve?

Cumulative confirmed COVID-19 cases in selected countries from day 1 to 40 after 100+ cases

As of March 30, 2020
Source: Johns Hopkins University
Exponential Spread, USA

New coronavirus cases announced in the U.S. each day

Source: C.D.C., state and local health agencies, hospitals.
March 30
When will COVID-19 peak in the USA? Depends on our actions NOW.

It left unmitigated, some epidemiologist-modelers anticipate a peak sometime mid-summer with different peaks for different states.

*The figure is but one estimate ...it may well change.*
1. Daily new cases begin to decline after the peak. Hospital load will still increase for another 10-15 days.

2. Epidemic Peak: new cases begin to decrease compared to daily cases with an outcome. Maximum hospital load.

3. New cases trend towards zero. Still high hospital load.
It is likely there will be two or more peaks in disease prevalence

• Expect to see multiple peaks in the disease once control measures are relaxed until enough immunity has built up in the population, or until we are able to develop an effective vaccine against COVID-19 (SARS-CoV-2)

• We are likely to see a rebound in cases once social distancing measures are lifted until we develop, mass-produce, and distribute a vaccine, which experts say will take 12-18 months, or we can find effective ways to treat COVID-19.

• The appearance of multiple waves can also occur because peaks may be occurring at different times in different locations due to differences in control measures, weather, and the movement of people.

• It is likely that this outbreak will only end when enough people have become immune to the virus and we achieve herd immunity.
Herd immunity

And the COVID-19 infection curve that everyone is talking about
Herd immunity is key to control in an epidemic like this

- Herd immunity (also known as community immunity) is defined by the CDC as “a situation in which a sufficient proportion of a population is immune to an infectious disease (through vaccination and/or prior illness) to make its spread from person to person unlikely.”

- The theory behind herd immunity is that when someone gets vaccinated, it’s not only that person who is protected from infection—they can’t transmit the disease to other people.

- Herd immunity protects people who cannot be vaccinated because their immune systems aren’t strong enough and are therefore the most vulnerable to serious illness.
An example of herd immunity via vaccination is the measles outbreak among preschool-age children in the United States

- In the late 1980s, the attack rate of measles decreased faster than an increase in the rate of vaccination coverage
- Researchers who examined the association between incidence of measles and immunization coverage among preschool-age children concluded that immunization coverage of about 80% may be enough to stop sustained measles outbreaks in an urban community
COVID-19 is different from measles as there is no vaccine: So the herd immunity situation is different

- There’s no vaccine for COVID-19 yet – there will probably not be one available to the public for a year.
- The only option is immunity after recovery from the virus. This means the majority of people will need to catch the virus at some point in time.
- But not at the same time or the health system gets swamped.
- The curve everyone is talking about entails spreading out the rate of infection to reduce case load in hospitals for the severely ill.
Proactive measures taken early in an epidemic reduce burden on the healthcare system and slow the spread of disease.
Why is testing so important?

• It is important to diagnose people quickly and to prevent spread of COVID-19 to the community through isolation of infected people and contact tracing when feasible.

• Effectiveness seen in South Korea
  • Used the WHO validated test and made a simple decision: Test as many people as possible even with minor suggestive symptoms and get results back quickly
  • Contact trace
  • Isolate

• If we only wait until one is very ill to administer a test—those with minor or no symptoms spread the disease
Until March 8, the CDC reported data only on specimens tested, not people. This estimate is based off the rule of thumb that two specimens are required per person.

Source: The COVID Tracking Project, KCDC, the CDC, Washington Post
There are two types of tests: PCR (polymerase chain reaction) and serological

- The PCR diagnostic test used in the United States at present identifies people who are currently spreading the virus. The test does not reveal who has previously been infected.
  - PCR for COVID-19 requires a nasal swab or sputum sample that identifies the specific viral RNA from the COVID-19 virus. It’s the gold standard to see if you are actively infected.
  - PCR detects the presence of this virus molecule in a person. It does not detect the effect of a virus, that is, disease. A person can be PCR positive before they have symptoms.

- A blood-based serological test detects antibodies that people produce after they've become infected. These antibodies can appear in the blood weeks after infection. Antibodies do not detect the current presence of the virus: they detect the immune system’s response to the presence.
  - This test has epidemiological as well as diagnostic uses.
  - It has been employed in China, Taiwan, and Singapore and is currently being developed in the USA.
Why are there false negative PCR tests?

There are a number of reasons a PCR test might be negative when a person is sick with the coronavirus:

• It might be too early in the illness, when the amount of virus in the airway is still small (i.e., the virus hasn’t multiplied enough).

• It could be a problem with how the swab was done.

• There could be issues with the handling or transport of the swab.

• There could be laboratory error.

• Note: The PCR test is only valid for a single point in time.
Why are serological tests so important?

- These antibody-based tests can identify people who were not known to be infected either because they never developed symptoms, or because they had symptoms that were never correctly diagnosed.
  - Very useful in contact tracing as demonstrated in Singapore*
- This test can identify silent infections, as well as people who were once sick, but have recovered
- These people can go back to work, care for sick patients, or potentially be antibody donors for convalescent plasma treatment for those ill with COVID-19.
- The big question is: Does a positive response for the antibodies mean that a person is actively infected, or that they have been infected in the past?
Developing a blood based serological test

Antigens are structural parts of a virus.

In the novel coronavirus, a series of spikes on the outside help the virus spread. The virus uses these spikes to bind to cells and infect them.

These spikes can be neutralized, or blocked by antibodies.

Antibodies are proteins produced by the immune system to fight infection.

How COVID-19 antibody testing works:

1. Researchers take lab-grown COVID-19 antigens and put them into special plates that immobilize them. Antigens are structural parts of viruses.

2. Health care workers take a sample of a patient's blood.

3. Parts of the blood containing antibodies are extracted into a serum. Antibodies are produced by the immune system to fight infection.

4. The serum and a detector antibody are added into the special plate mixture. Detector antibodies alert researchers to the presence of virus antibodies.

5. If COVID-19 antibodies are present, they will stick to COVID-19 antigens and block them.

6. The detector antibodies will stick to the COVID-19 antibodies to cause a reaction.

7. The reaction causes the liquid in the plate to turn blue. If the liquid turns blue, it means the patient has had or currently has COVID-19.
The only way of slowing down the number of cases and serious cases needing hospitalization in the USA at this time

Social distancing

Now

Not when there are many cases in your community
Social distancing buys us time

- So there is not a surge swamping our health care facilities, which need to serve not only COVID-19 cases, but a broad range of urgent as well as routine health problems
- To enable us to make and distribute essential resources needed by health care providers to keep both patients and themselves alive
- To develop better clinic and home-based tests for present and past COVID-19 infection
- To develop effective antiviral treatment options: both curative and preventive treatment as well as a vaccine
Chart 23: Model of Cumulative Cases of Coronavirus with Social Distancing Measures Taken One Day Apart

Source: Tomas Pueyo

- Cumulative cases
- Number of days
- No social distancing
- Social distancing one day later (n+21)
- Social distancing started on day n+20

+40%!
THE POWER OF SOCIAL DISTANCING

NOW

1 PERSON INFECTS

5 DAYS

2.5 PEOPLE INFECTED

30 DAYS

406 PEOPLE INFECTED

50% LESS EXPOSURE

1 PERSON INFECTS

5 DAYS

1.25 PEOPLE INFECTED

30 DAYS

15 PEOPLE INFECTED

75% LESS EXPOSURE

1 PERSON INFECTS

5 DAYS

.625 PEOPLE INFECTED

30 DAYS

2.5 PEOPLE INFECTED
How do we know social distancing and (when warranted) quarantine work?

We know from both history and what other countries have done already.
A tale of two cities in 1918 is telling: There is a reason for canceling public gatherings.
Lessons learned from Asian countries doing the best to contain the disease

• What has worked the best in Asia:
  • Early travel restrictions
  • Aggressive testing and screening of contacts
  • Strict quarantine rules

• Which countries:
  • Taiwan, Hong Kong, Singapore

➢ What they have in place enabling them to do so
  • Universal healthcare
  • Clear management structures for the public health response
  • Proactive communication protocols to get the population on board
  • Experience with containing SARS
Hong Kong and Singapore have limited the spread of coronavirus; S Korea is slowing the rate of infection. Most western countries show a similar trajectory.

Cumulative number of cases, by number of days since 100th case

FT graphic: John Burn-Murdoch / @jburnmurdock
Source: FT analysis of Johns Hopkins University, CSSE. Data updated March 13, 16:00 GMT © FT
Chart 3: Infections and Deaths If We Do Nothing in the US

Total Dead: >10,000,000

Transmission Dynamics

Population Inputs
Size of population: 329,484,431
Number of initial infections: 246

Basic Reproduction Number $R_0$
Measure of contagiousness: the number of secondary infections each infected individual produces.

Transmission Times
Length of incubation period, $T_{inc}$: 5.20 days
Duration patient is infectious, $T_{inf}$: 2.9 Days

Clinical Dynamics

Morbidity Statistics
Case fatality rate: 4.06%

Recovery Times
Length of hospital stay: 10 Days
Recovery time for mild cases: 11.1 Days
Time to hospitalization: 5 Days

Chart 8: Suppression Strategy According to the Imperial College

- **Surge critical care bed capacity**
- **Do nothing**
- **Case isolation, household quarantine and general social distancing**
- **School and university closure, case isolation and general social distancing**

Source: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand, Neil Ferguson et al., Imperial College
Ending a lock-down and returning to business too soon will lead to a second surge – persistence is necessary

• Hong Kong, one of the first places outside mainland China to see infections, provides a model for what happens when you go back to work too soon.*

• This week, the city sent civil servants back home after they returned to their offices around the start of the month. Numbers had been stable in Hong Kong when that decision was made, but imported infections combined with a lack of social distancing soon led to a new wave of local cases.
  • Experts are considering a Potential Long-Term Intervention Strategy in the future (not now) in which the curve is spread out to keep the curve low so as to avoid overwhelming healthcare capacity. Curve rises: we go back to rigorous social distancing and cases start to decrease.
  • Curve appears low: we back off extreme social distancing and follow prudent preventive health behavior

• This "lightswitch" approach would need to be carefully monitored with adequate testing and a good surveillance system – something the US does not have at present. This approach does not support President Trump’s “return to normal soon approach,” which flies in the face of public health wisdom.**
What to do at home

What not to do

Beyond obeying social distancing mandate
Wash your hands: learn how and with what

• Standard message: Wash your hands with soap thoroughly for 20 seconds and/or use a greater than 60% alcohol-based hand sanitizer

• ****Soap and water is more effective than hand sanitizers
  ➢ Use hand sanitizer when no soap and water alternative
  ➢ baby wipes are not effective

• Whenever you return home from ANY activity that involves locations where other people have been, wash your hands with soap

• Money exchange is a possible route of transmission
  • Wash hands afterward
  • Do not try to launder money by microwave—it does not work
Clean surfaces you routinely touch – or that are touched by others – often

• Counters, door knobs, steering wheel, bathroom
• cell phones, computer keyboards
• Use appropriate cleaning products (look up approved list cited in notes)****
  • An effective bleach solution can be made by mixing 1/3 cup or 5 Tablespoons per one gallon of water or 4 teaspoons or 20 cc per quart.
• How about ultraviolet light devices?
  • Only type C are effective and only for smooth surfaces (think cell phone or a screen). UV-C penetrates superficially, and the light can’t get into nooks and crannies. It also irritates skin (not to be used on hands or face)
How about doing laundry if I suspect that I or a family member has COVID-19?

- If you’re caring for someone in the house who is sick or you’re cleaning the clothes of a family member who may have been exposed to the coronavirus, consider those clothes contaminated and keep them in a separate laundry bin until it’s time to do the wash.
  - Place a washable or disposable liner in that laundry bin so that you can either launder it or throw it away after you remove the dirty clothes.
  - Use gloves in handling clothes and/or wash hands immediately after
- Wash contaminated clothes and linens as usual, but “launder items using the warmest appropriate water setting for the items and dry items completely
- Bleach may help inactivate viral microbes in the wash. So if you’re washing whites and light colors, you could add bleach to the load. Or you could use a detergent that contains a color-safe bleach if it’s appropriate for the fabric
- Once the washing is done, using a dryer may be better than hanging the clothes to dry because the heat may also help inactivate any viral microbes. Dry fabrics are less likely to transfer germs than wet ones.
- Clean surfaces of washing machine and the laundry bin with bleach or other household disinfectant after you’ve removed the dirty clothes.
To mask or not to mask?

• **Wearing a mask will probably make little difference if you’re just walking around town.**

• If wearing a mask is the only way to keep from touching your nose and mouth in public they serve that purpose -- but they are not comfortable
  • They are symbolic – psychologically comforting – a form of harm reduction rendering a feeling you are doing all you can do

• If you’re showing symptoms of coronavirus, or have been diagnosed, wearing a mask protects others.

• If you are likely to be in close contact with someone infected, a mask cuts the chance of the disease being passed on.
  • Masks are highly recommended for family members who need to care for someone who is ill – ideally both the patient and caretaker should have a mask.

• If you are >65, especially if vulnerable due to a precondition, wearing a mask when in public is warranted. But remember, it is best not to be in public unless absolutely necessary.

• If your work in essential industries exposes you to people in close quarters, it makes sense to wear a mask.
How about the rest of us? There is mixed informed opinion about wearing a mask

• If you are asymptomatic and contagious, masks might reduce the spread of disease. In Asia, it is widely believed that wearing masks slows down the spread of the virus in public.
  • There is some evidence suggesting this may be the case from several different countries *
  • Refer to slides on how long the virus may remain in the air in enclosed air-conditioned environments like a bus and the large percentage of asymptomatic cases capable of spreading the disease

• In terms of protecting the healthy, opinion varies beyond an appeal to reserve our limited number of surgical and N95 masks for health care providers and those in essential services.

• Read the references provided and the slides that follow and make your own decision.
If I decide to wear a home made mask, what material is most effective?

- Double layers: Overall, double layers do not help much. The double-layer pillowcase captured 1% more particles, and the double-layer shirt captured just 2% more particles.
- Looking at the data, the dish towel and vacuum cleaner bag were the top-performing materials.
- However, the researchers chose the pillowcase and the 100% cotton t-shirt as the best materials for DIY masks due to breathability.
- These materials filter out approximately 50% of 0.2 micron particles, similar in size to the coronavirus.
Mask effectiveness before and after 3 hours

Mask Effectiveness Before and After 3 Hours

- Dish Towel: Before 63.0%, After 68.8%
- Surgical Mask: Before 77.7%, After 78.1%
- N95 Mask: Before 99.1%, After 98.2%

After being worn for 3 hours, homemade mask captured 5% more particles.

Open-data tests: Smart Air smartairfilters.com
How about washing masks and reusing them?

- **Surgical masks**: Avoid washing or sterilizing any part of surgical masks using water, alcohol, dishwashing solution, hand wash, soap or any kind of detergent.
  - If outer and inner layer of the surgical mask is damaged, it loses its filtration and water-resistant functions.
- **N95 masks**: Washing these masks with soap and water is much worse than natural “aging.”
  - Washing decreases particle capture by 21%. Cleaning with rubbing alcohol reduced effectiveness by 37%
- **Masks you have made yourself**: Use them and then throw them away. Cleaning is tricky and not advisable. Cleaning opens too many chances of spreading the virus in your house.
- **When taking off mask at home**:
  - Have soap or sanitizer readily available.
  - Take off mask and discard in a lidded rubbish bin.
  - Wash hands immediately.
Caution when wearing homemade masks

• If you wear a mask, then you must know how to use it and dispose of it properly.
• If used incorrectly, the mask may end up contaminating you more than not wearing a mask at all.

Three common mistakes:
• Less diligence complying with social distancing recommendations when wearing a mask, placing you at greater risk.
• Touching your mask and then your face often. Masks are uncomfortable and people fiddle a lot adjusting them and taking them on and off. This may expose you to the virus more because your mask gets contaminated.
• In the process of trying to clean a mask, you may contaminate yourself and your home.
Wearing masks can have symbolic value

- **Civic responsibility**: In Asia, wearing a mask is not seen as just a means of protecting yourself from getting infected, but also seen as an act that minimizes the chance of infecting others with a potential infection harboring in your body
  - This is a sign of health citizenship*

- **If all people wear a mask there is no stigma associated with wearing a mask**
  - In this case, it does not signal that you are a “dangerous other”
  - It rather indicates you are a responsible other
  - Aside from places like Japan, the Czech republic instituted a policy of all citizens wearing masks as a control measure. Both the symbolic and epidemiological significance of this act are noteworthy.
    - In just 10 days, the country went from no mask usage to nearly 100 percent usage, with nearly all the masks made at home with easily accessible materials, like old t-shirts.**
Surgical vs. N95 masks

• N95 masks are to protect YOU from the secretions of others, and the surgical mask is to protect others FROM you.

• Although surgical masks are in widespread use by the general population, there is no evidence that these masks prevent the acquisition of COVID-19, although they might slightly reduce the spread from an infected patient breathing in your face.

• A well-conducted, large, cluster randomized trial, undertaken largely in US primary care settings, did not identify a meaningful benefit from N95 respirators when compared to surgical masks for the prevention of influenza among staff.**

• N95 masks are most needed by those in hospital settings and are in short supply.
Masks are in short supply for health care workers

- Do not stockpile and use only when sick
- Conserve them so those who work in health care settings have adequate protection until the supply is plentiful
Food or food packaging has not been identified as a risk factor for COVID-19 transmission

• Currently there is no evidence to support transmission of COVID-19 associated with food (food itself—not packaging or handling)

• There is likely very low risk of spread from food products or packaging that are shipped over a period of days or weeks at ambient, refrigerated, or frozen temperatures.

• Your biggest risk, especially if you are ordering takeout, is most like the person who delivers your food.

• There is also no evidence to support transmission of COVID-19 associated with imported goods and there have not been any cases of COVID-19 in the United States associated with imported goods.
Do not engage in diagnosis by treatment

Do not take left-over antibiotics you have at home to see if your respiratory illness is bacterial or viral.
Get a flu buddy and prepare your home

• Get a flu buddy (aka “pandemic pal”) and make back-up plans for care of children, pets, and those in need of special assistance

• Prepare a hot zone in your home just in case someone falls ill

• Stock up on essential foods and medicines, etc.
Young Kids and COVID-19 spread

- Data from the epidemic in China: kids get infected at the same rate as the population average.
- Kids are less likely to get severely sick than adults, but are just as contagious.
- Parents and grandparents can get very sick from children.
  - Limit contact with *grandparents > 60 years of age, especially if suffering from a chronic disease like diabetes or respiratory problems or if a smoker.
- Play: Form a small playgroup and play outside. Adults should stand > 6 feet away from children other than their own.
  - Don’t go into each other’s homes.
  - Playgrounds: COVID-19 virus can live on surfaces for hours or days in a laboratory environment, but there are no data that I am currently aware of regarding survival of the virus on playground equipment.
Why schools have to be closed
What if I suspect my child has COVID-19?

• If you think symptoms are serious enough to see a doctor, call your doctor

• If your child has the virus, clinicians will provide supportive care to children with COVID-19

• No special antiviral drugs have been approved for treatment
What if I have symptoms and am concerned I might have COVID-19?

• If you have a high fever, a persistent cough, or signs of respiratory distress such as shortness of breath you need to seek medical attention.

• What to do: Call ahead to your doctor or emergency care facility. Do not just walk in or you risk other lives.
  • Waiting rooms are often full of older patients with heart disease, cancer, and other conditions for whom the coronavirus could be fatal

• Call ahead and receive instructions.

• If symptoms are not severe you will be given instructions on how to self treat and monitor your symptoms and if a test is necessary and available at the time of assessment by phone.
Danger signs of COVID-19

• The big one is difficulty breathing
• Trouble breathing: get medical attention.
• **When seeking medical attention: call first.**
  • Call your doctor or emergency room before going in and tell them your symptoms. They will tell you what to do.
• **Wear a facemask:** If available, put on a facemask before you enter the health care facility.
• Try to stay at least 6 feet away from other people in the waiting room.
What does COVID-19 do to the lungs?

- Covid-19 often begins as an upper respiratory tract infection.
- Among some, the virus travels down the throat and enters the lower respiratory tract.
- If that happens, the virus damages the lung’s tiny air sacs — alveoli — where oxygen enters the blood and carbon dioxide leaves.
- Inflammatory cells and fluid then render the alveoli unable to do their job. This makes it more difficult for oxygen to travel from the lungs into the bloodstream starving bodily organs (causing acute respiratory distress syndrome)
- When this becomes an acute condition one has to be placed on a ventilator. The ventilator is not a treatment to heal damaged lungs; It gives the lungs a longer time to recover on their own.
What else can I do if I feel I am “coming down with something”

• There are additional measures that may reduce the risk of infection and the severity of viral respiratory diseases in general:

• Care for your throat and engage in practices that support the self-cleaning powers of the respiratory tract
  • Like what? Gargling with salt water or antiviral mouthwash, steam inhalations...true for all types of influenza

• Zinc supplements may reduce the duration of the illness and are available in capsule, tablet, and lozenge form. One review of seven studies showed that zinc lozenges containing 80-92mg of zinc may reduce common cold duration by up to 33%. Zinc-containing nasal sprays should be avoided. ***
Personal Notes

- We need to get past fear-based messaging to community-based messaging and messaging that appeals to our sense of global as well as local health citizenship.

- COVID-19 needs to be treated as a family and community disease – if it is, the pandemic will be controlled faster – We learned this with Ebola. We need to provide those who need to self-quarantine with the resources to enable them to do so.

- We need to get into the weeds with a “devil in the details” approach to keeping ourselves safe.

- **Above all else: stay put, cocoon**

- Social distancing does not mean social disconnection – this is a time for community building, not social isolation at the personal or country level. We are in this together.
This is a test of family and cultural values as well as political responsibility.

- It is also a time for thinking about serious health care reform and the need for safety nets enabling public health recommendations to be implemented quickly by the average citizen = sustained economic support during the crises for all, especially the most vulnerable

- We must be prepared for periodic pandemic and reemerging disease threats. They are really not all that uncommon!!!
This is not a one time unforeseen pandemic—we need to invest in preparedness and rapid response systems. We must be prepared for a future in which emerging and re-emerging diseases are expected.
Preparedness and Response Framework for Pandemics

- **WHO phases**
  - Preparedness
  - Response
  - Recovery

- **Containment**
  - Intensify case finding and contact tracing
  - Isolate cases and quarantine contacts
  - Characterize illness
  - Prepare for mitigation with nonpharmaceutical interventions (NPI)

- **Mitigation**
  - Deploy medical interventions
    - Antivirals, vaccines
  - Early institution of multilayered NPIs

- **Transmission outpaces containment efforts**

- **CDC intervals**
  - Investigation
  - Recognition
  - Initiation
  - Acceleration
  - Deceleration
  - Preparation

Your responsibility as a university professor

• Aside from staying safe yourself, making sure your students are not compelled to be in spaces where they are going to be exposed
  • For example, university students without internet who may go to coffee shops to get online
  • Provisions for them to get internet to complete classes

• Educating youth about why their social distancing is so important to containing this disease and preventing the swamping of our health care system which is ill prepared for a large surge
  • Making this an ethical and citizenship issue

• Dispelling the impression that “youth will only get a mild case with flu-like symptoms which is no big deal”
  • Note: More young people are being admitted to hospital in Italy with coronavirus, as the outbreak continues...this follows a first wave of the elderly being hit hard
As an engaged anthropologist what can you do

Action items: here are a few examples

• Social determinants of health: Beyond looking at rates of disease by group, consider the ability of specific groups in specific home, community, and work environments to adhere to public health social distancing guidelines
  • Identify constraints and opportunities for reducing risk
    • What may be done to reduce risk of contagion that is feasible
    • What resources would make a big difference
    • Move the discussion from groups at risk and risky behaviors to environments of risk ***

• Identify what information sticks and does not stick given all that is out there and changing on a day by day basis –Participate in translational research efforts and identifying / supporting local spokespeople who are trusted and can act as filters of information
As an engaged anthropologist what can you do

- Remind everyone that the household is an important unit of analysis: the families of both the ill and health care providers whose families themselves may be seen as dangerous to interact with and be indirectly stigmatized.

- Consider opportunities for social connection and support for different types of people at this time of high risk contagion so social distancing does not become social isolation over what is likely to be a several month social isolation trajectory.

- Document “what if” scenarios as a means of getting people to engage in anticipatory problem solving.
  - For example, given different contexts, what would you do if you live alone and fall ill—how would you get resources?
  - What would you do if your children or grandchildren fell ill?
  - Given X means of employment, what is the best ways of protecting yourself while getting to work and while at work, and so on.

- Work with your community to get out practical scenario driven advice.
Concerns

> Political partisanship may be our undoing if it undermines public health dictates

- Youth will blow this illness off and not social isolate
- Elders will not self isolate because they want to be close to their families and grandchildren
- People will try and escape hot spots by leaving and going to other “safer” places or places with better medical care and thus spread the illness
- Confusing and contradictory messages by political leaders will lead to confusion and distrust of messages at a time when transparency and evidence based problem solving is needed
- Malicious messages misleads the public, undermines trust, and fosters epidemic fear
The Online Coronavirus Threat

Known coronavirus-related malicious online threats, by type*

- Malicious spam emails: 199,379
- Malicious files: 81,315
- Malicious URLs: 22,767

* Threats detected from January 1 to March 27, 2020.
Source: Trend Micro

The Countries Targeted Most by Malicious Coronavirus Spam

Countries targeted by largest share of global malicious spam emails with "coronavirus" in the subject

- United Kingdom: 20.8%
- France: 11.5%
- United States: 8.2%
- Italy: 5.9%
- Belgium: 5.2%
- Germany: 5.1%
- India: 4.9%
- Netherlands: 3.5%

* January 1 to March 27, 2020.
Source: Trend Micro
Where People Are Most Skeptical of COVID-19 Restrictions

Share of respondents in selected countries who said travel restrictions/isolation would not stop COVID-19

<table>
<thead>
<tr>
<th>Country</th>
<th>Skeptical Share</th>
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<tbody>
<tr>
<td>Japan</td>
<td>62%</td>
</tr>
<tr>
<td>India</td>
<td>61%</td>
</tr>
<tr>
<td>Germany</td>
<td>55%</td>
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<tr>
<td>Australia</td>
<td>52%</td>
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<tr>
<td>U.S.</td>
<td>46%</td>
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<tr>
<td>China</td>
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<tr>
<td>Italy</td>
<td>37%</td>
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<tr>
<td>France</td>
<td>36%</td>
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</table>

Survey of 14,000 people 16-74 y/o in 14 countries, March 19-21, 2020
Source: Ipsos
Bottom line:
Stay put, cocoon.
Check in on your family, friends, neighbors. Don’t just think of yourself.

Your grandparents were called to war. You're being called to sit on your couch. You can do this.
COVID-19 response will require adaptation over time on several different levels.