



Community Guide to COVID-19 and SARS-CoV-2

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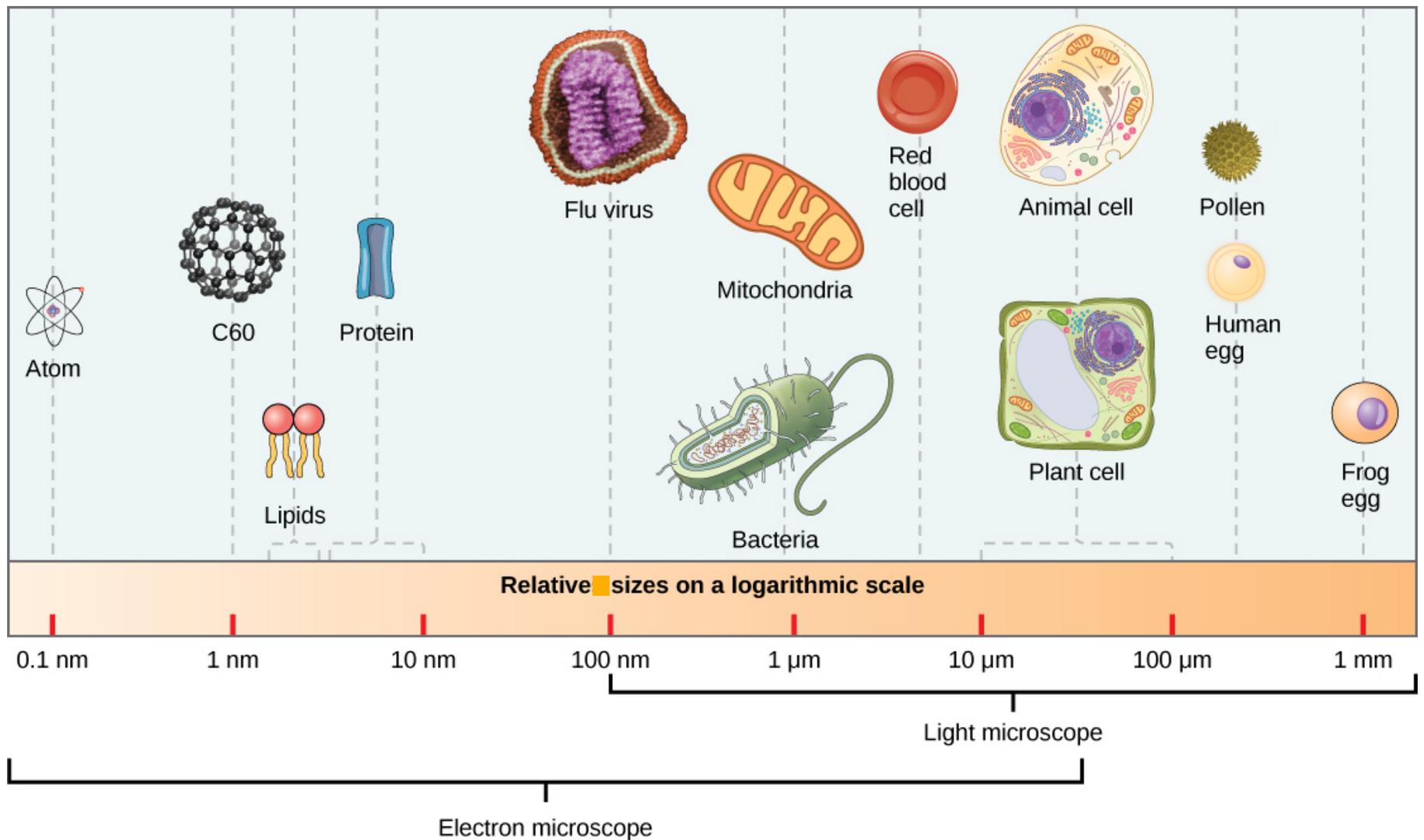
Image: <https://www.nih.gov/news-events/news-releases/nih-clinical-trial-investigational-vaccine-covid-19-begins>

Overview of this information packet

- What is a virus? How is SARS-CoV-2 different from bacteria or other viruses
- Sudden Acute Respiratory Syndrome CoronaVirus = SARS CoV-1/2
- COronaVirus Disease 2019 = COVID-19
- How dangerous is it?
- What are ways to disinfect?
- Information on Physical Distancing and masks
- Follow up on treatments & vaccines and what we currently have data to help guide us forward

What is a virus? How is different than other pathogens?

- A virus is a very small infectious agent. They replicate via taking over bacterial, plant or animal cells to make new proteins and genomes (RNA or DNA)
- There are 3 main types of virus: RNA viruses (e.g. influenza, coronaviruses), DNA (herpes), or retroviruses (make RNA->DNA; HIV)
- RNA viruses tend to have smaller genomes, more mutations and kill cells spraying virus particles everywhere, DNA and retroviruses tend to keep cells alive to parasitize them (ideally). Herpes viruses have very large genomes almost the size of bacteria!
- Bacteria are bigger. Some infect cells, many live outside as either single cells or in groups (biofilms). Same with many fungal pathogens and parasites. They generally have bigger genomes and many weapons.



Molnar, C. and J. Gair. (2015). Concepts of Biology: 1st Canadian Edition. Victoria, B.C.: BCcampus. Retrieved from <https://opentextbc.ca/biology/>

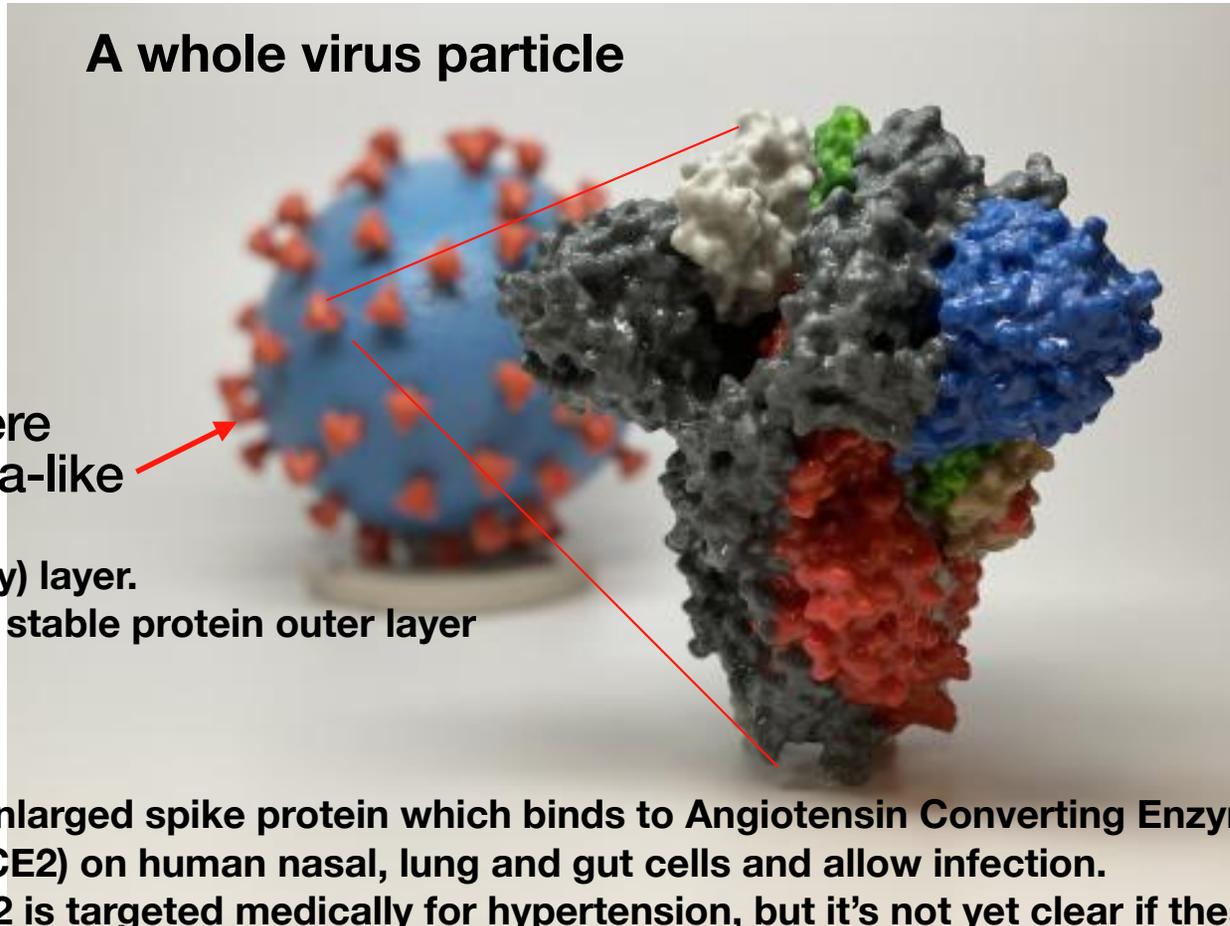
What is a coronavirus?

A whole virus particle

Corona = crown or projections from sphere
Spike protein = corona-like

The blue layer is a lipid (oily) layer.
Some viruses have a more stable protein outer layer

An enlarged spike protein which binds to Angiotensin Converting Enzyme 2 (ACE2) on human nasal, lung and gut cells and allow infection. ACE2 is targeted medically for hypertension, but it's not yet clear if these drugs affects infection or disease.



What is this virus? Where did it come from?

- There are many Coronaviruses. At least 5 of the known 7 that infect humans and cause disease are very similar to bat Coronaviruses. There are thousands of coronaviruses in the animal world, most unknown yet.
- 4 of the 7 viruses cause “colds,” second leading virus after rhinoviruses (which do not come from rhinoceroses)
- SARS-CoV-1 may have gone from bat to civets to us by accident. We call this zoonotic disease. MERS-CoV comes from camels. SARS-CoV-2 may be bat to Pangolin, which are a delicacy in China.



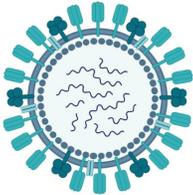
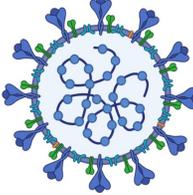
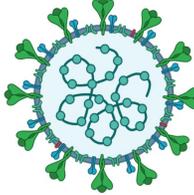
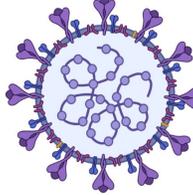
What are the characteristics of the disease?

- This is a perfect nightmare. ~50% of infected carriers do not show disease but are infectious. In young health adults and children, many (80-90%) have no symptoms but can spread virus.
- Elderly and people with certain medical conditions (diabetes, heart diseases) are at very high risk of dangerous disease, including pneumonia and loss of oxygen
- 10-20% will develop symptoms but not necessarily have a fever. Fever is very common with most other viruses.
- Symptoms include fever, shortness of breath, body aches, dry cough (no phlegm), new loss of taste/smell, chills/shaking, sore throat, headache, muscle pain, and diarrhea
- Estimates that 1 in 100 under the age of 50 will die by pneumonia. Over 50 it becomes much more dangerous. Over the age of 80, it may kill more than 10% of the acutely ill.

<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

Epidemiological Comparison of Respiratory Viral Infections

From Dr. Akiko Iwasaki (Yale)

Disease	Flu	COVID-19	SARS	MERS
Disease Causing Pathogen	 Influenza virus	 SARS-CoV-2	 SARS-CoV	 MERS-CoV
R_0 Basic Reproductive Number	1.3	2.0 - 2.5 *	3	0.3 - 0.8
CFR Case Fatality Rate	0.05 - 0.1%	~2% overall in developed nations	9.6 - 11%	34.4%
Incubation Time	1 - 4 days	4 - 14 days *	2 - 7 days	6 days
Hospitalization Rate	2%	~19% *	Most cases	Most cases
Community Attack Rate	10 - 20%	30 - 40% *	10 - 60%	4 - 13%
Annual Infected (global)	~ 1 billion	>3.8 million confirmed	8098 (in 2003)	420
Annual Infected (US)	10 - 45 million	>1.27million (confirmed)	8 (in 2003)	2 (in 2014)
Annual Deaths (US)	10,000 - 61,000	>75000	None (since 2003)	None (since 2014)

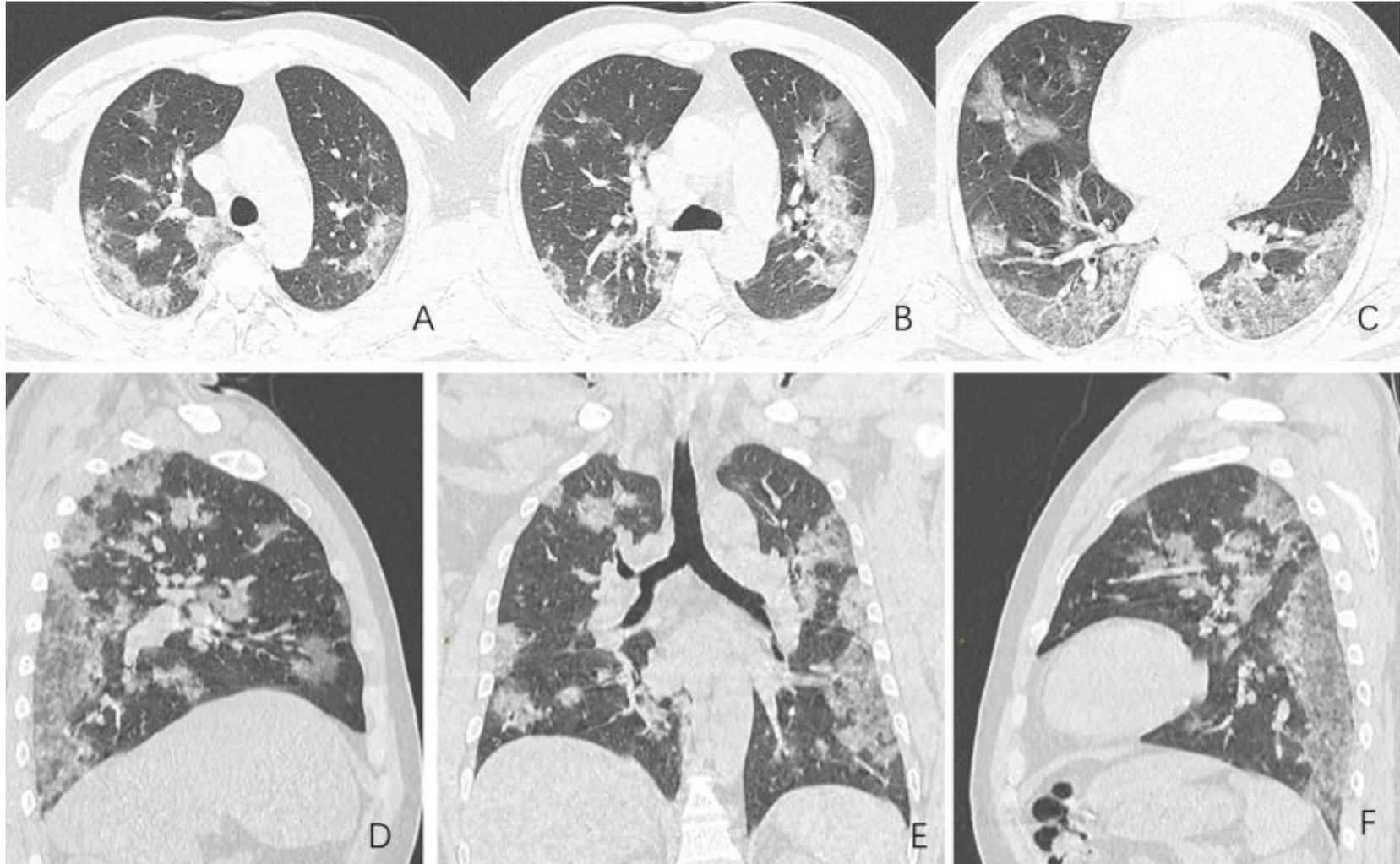
shedding time: 5-10 days 10-40 days (avg 20)

* COVID-19 data as of March 2020.

Pathology of disease

- **Breathing in human airways: Nose/mouth ->Trachea -> Bronchi -> Bronchioles ->Alveoli (gas exchange to red blood cells in capillaries)**
- When the alveoli are destroyed and/or flooded with fluid (pneumonia),no gas exchange, lack of oxygen (hypoxia)
- Cytokine Storm = Hyperinflammation that accidentally can be destructive

Computed Tomography (CT) scans show widespread destruction of peripheral alveoli



<https://www.newsweek.com/ct-scans-coronavirus-lungs-covid-19-sufferers-1491997>

How does the virus spread? How long does it last?

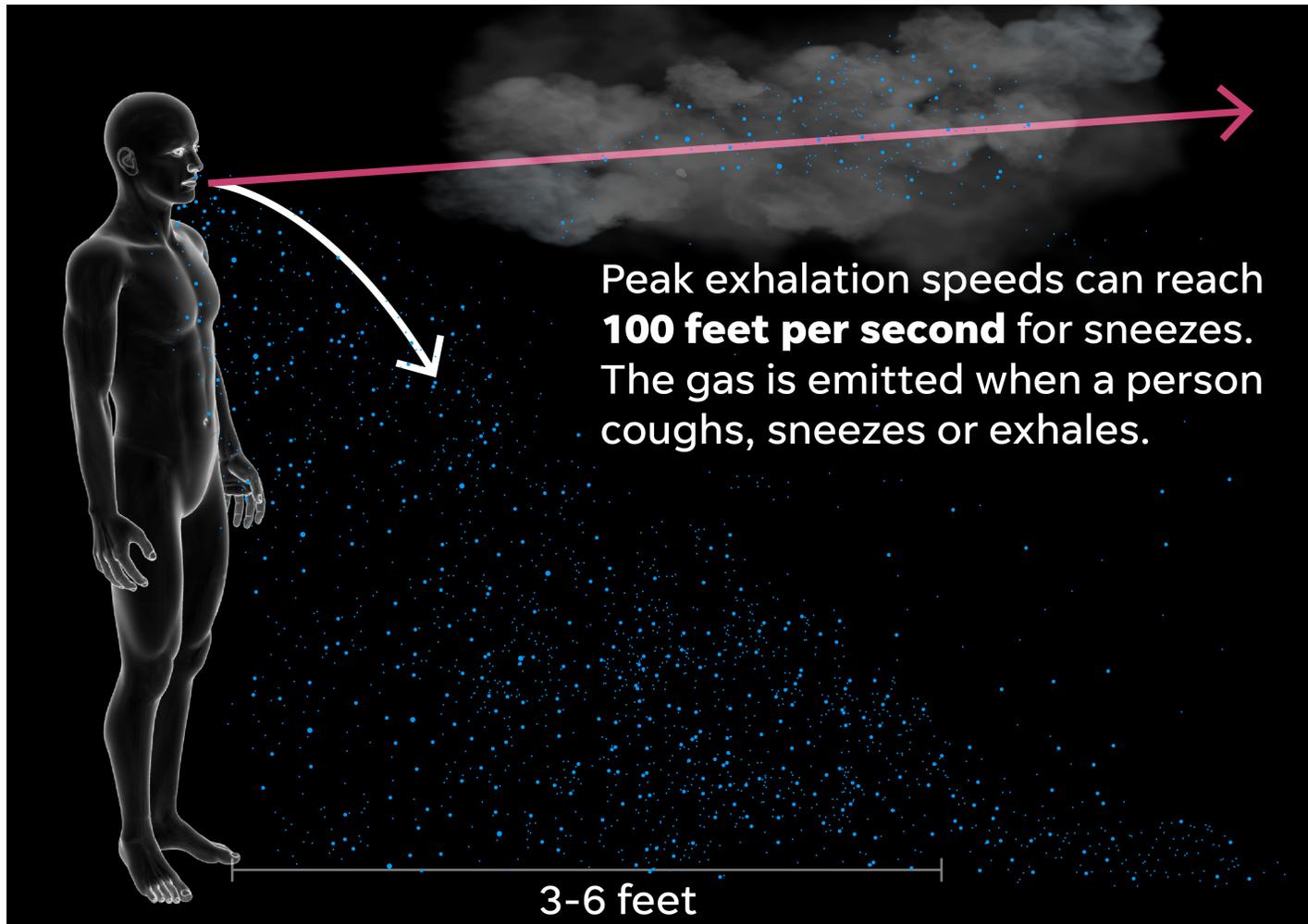
- **How do you contract a virus?** This virus spreads in small exhaled or coughed droplets.
- **How long does a virus survive outside the body?** Two studies have shown it can survive for at least two days on a clean, room-temperature surface. Most real environments are less likely to have it last this long. It can survive only an hour or two in the air. Ventilation and being outside reduces the concentration of virus. Sunlight and drying out the droplets probably disables the virus as well (but slowly).

<https://operationwecansewit.com>

Mask basics

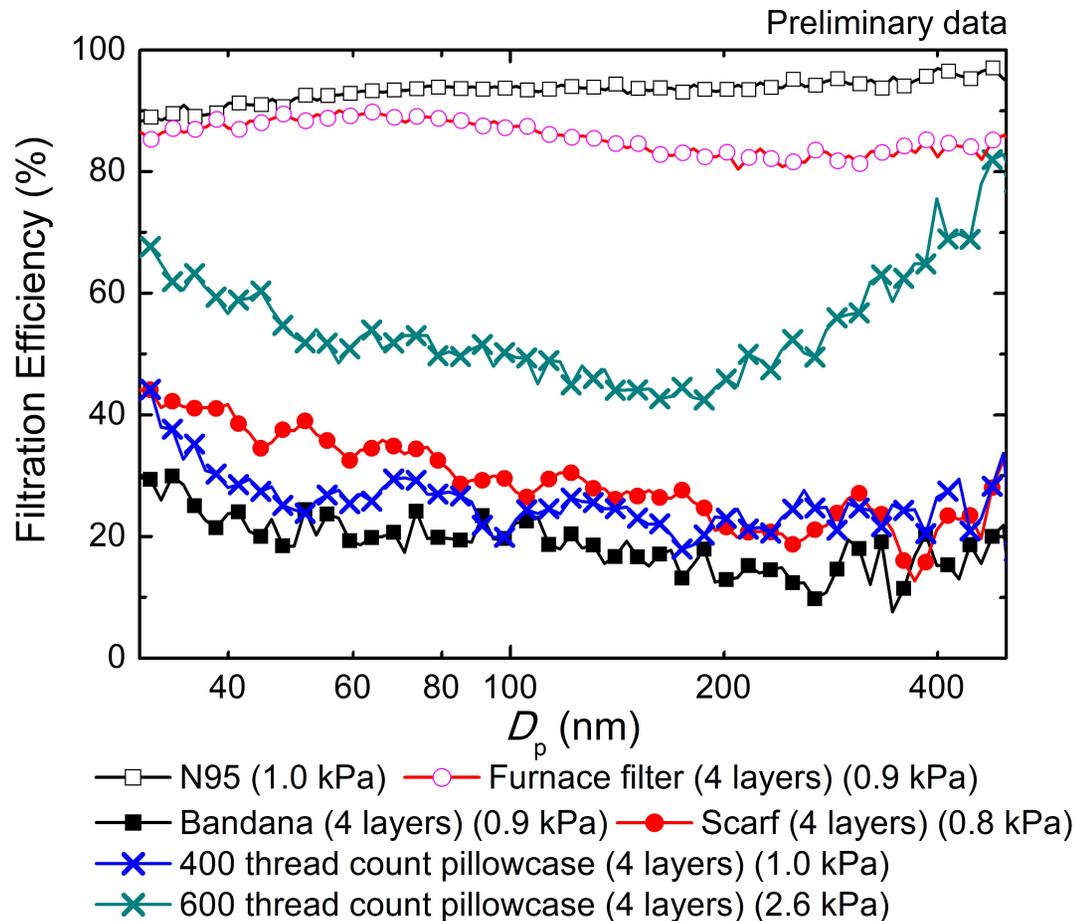
- Masks work by capturing these small exhaled or coughed droplets. Even a bandana can capture some droplets. ER/ICU workers around sick patients need high biological filtration masks called N95s (they filter at least 95% of the droplets).
- It's important to find and use a mask that fit tightly at the outer edges so that your breath goes through and is filtered the mask. Metal around the nose helps it fit best and prevents fogging of glasses. Denser masks are better, but if too dense, may not be very breathable. Towel material has been reported to work fairly well.

<https://operationwecansewit.com/summary-of-evidence/>



<https://www.usatoday.com/in-depth/news/2020/04/03/coronavirus-protection-how-masks-might-stop-spread-through-coughs/5086553002/>

Any mask, even a bandana helps. Please don't put a furnace mask on your face due to potential fiber inhalation.



Reference: Carl Yang Wang Assistant Professor
<https://www.mst.edu>
<https://twitter.com/carlyangyang/status/1245925586868015104?s=20>

- **Be careful taking off a used mask and clean it without contaminating yourself!**

Washing hands & preventing contamination

- **What are known ways to disinfect?** Soap and warm water can disrupt the structure of this virus, which has a lipid (oily) outer layer. Hand sanitizer and rubbing alcohol also disrupt the lipid layer of the virus. Hand washing is best because it also physically removes the virus from skin. Wash for at least 30 seconds with careful rubbing. Use lotion to reduce dry hands and cracking. Clothes washers/dryers & dishwashers will all work to clean contaminated clothing and small dishwasher safe items.
- **It's really important to not touch your unwashed hands to your face (esp. mouth, nose, yes) or other items when you may have touched something others outside your house may have handled.** You can also accidentally contaminate your phone, hair, clothes, or purse so getting a bottle of hand sanitizer really can go a long ways towards minimizing this. Again, very important if you are caring for elderly or vulnerable people in your household.

Chemical Disinfection

- **Chemical disinfectants:** Lysol and other disinfecting cleaners, hydrogen peroxide, and bleach cleaners destroy and disrupt virus proteins, genomic RNA, and the outer lipid layer. **Use chemical disinfectants for at least 1 minute on contaminated items. and then consider ways to rinse off the disinfectant safely and thoroughly as it can be toxic.**
- Most cleaning wipes (not toilet/diaper wipes) are fairly effective as well.
- **Be very careful with chemical disinfectants.** Do not mix disinfectants. Dispose of them safely. Some disinfectants can stain or damage some items (e.g. bleach on colored fabrics, peroxide on leather, alcohols on some plastics). Keep them away from children and pets.

Care for the ill

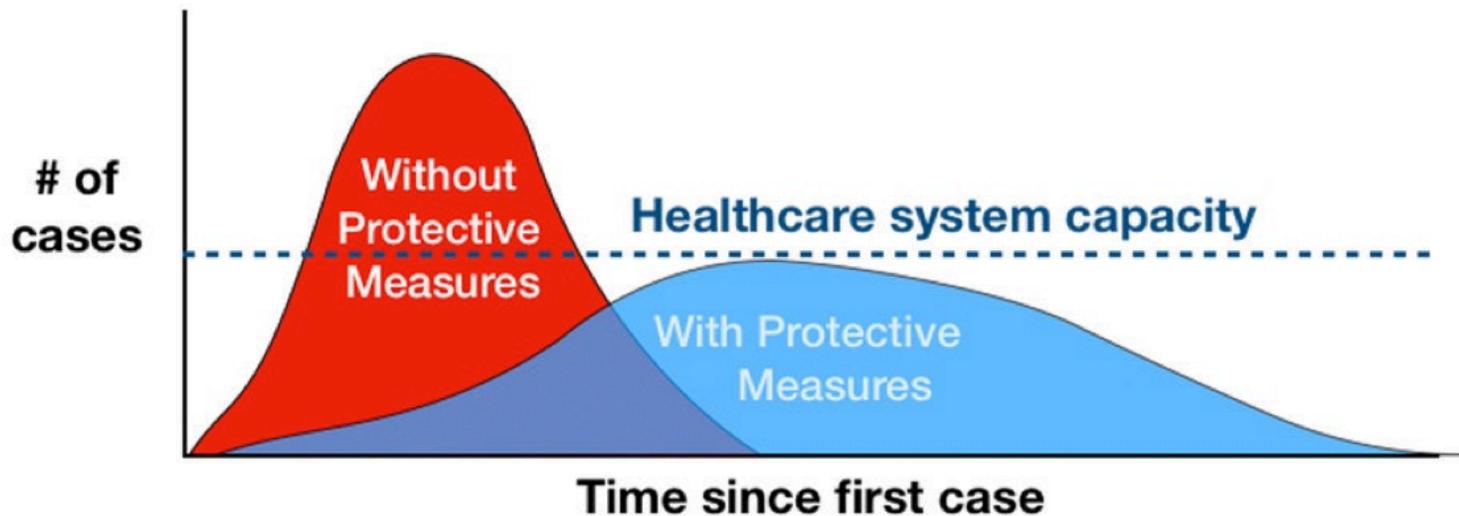
- If you or someone in your house develops symptoms, please contact your doctors office immediately
- Get tested as soon as possible. This has been real challenge so far.
- Isolation and care of the ill person can be hard. A bedroom with their own bathroom if possible. Help get them meals and fluids. Wear a mask when helping them, and monitor their breathing. If they become blue, have chest pain, or confusion, call 911.
- Be careful with clothing, bedding, and items handled by ill person. Wash immediately. You might considering showering after being in same room.

Full recommendations here:

<https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/care-for-someone.html>

Physical Distancing

- **Physical distancing: Safest to be >6 feet away from others who are not in your own household when in public.** Limiting contact/interactions by minimizing group sizes and potential exposures to asymptomatic carriers helps reduce the spread and no risk overwhelming the limited number of ICU facilities for the critically ill.



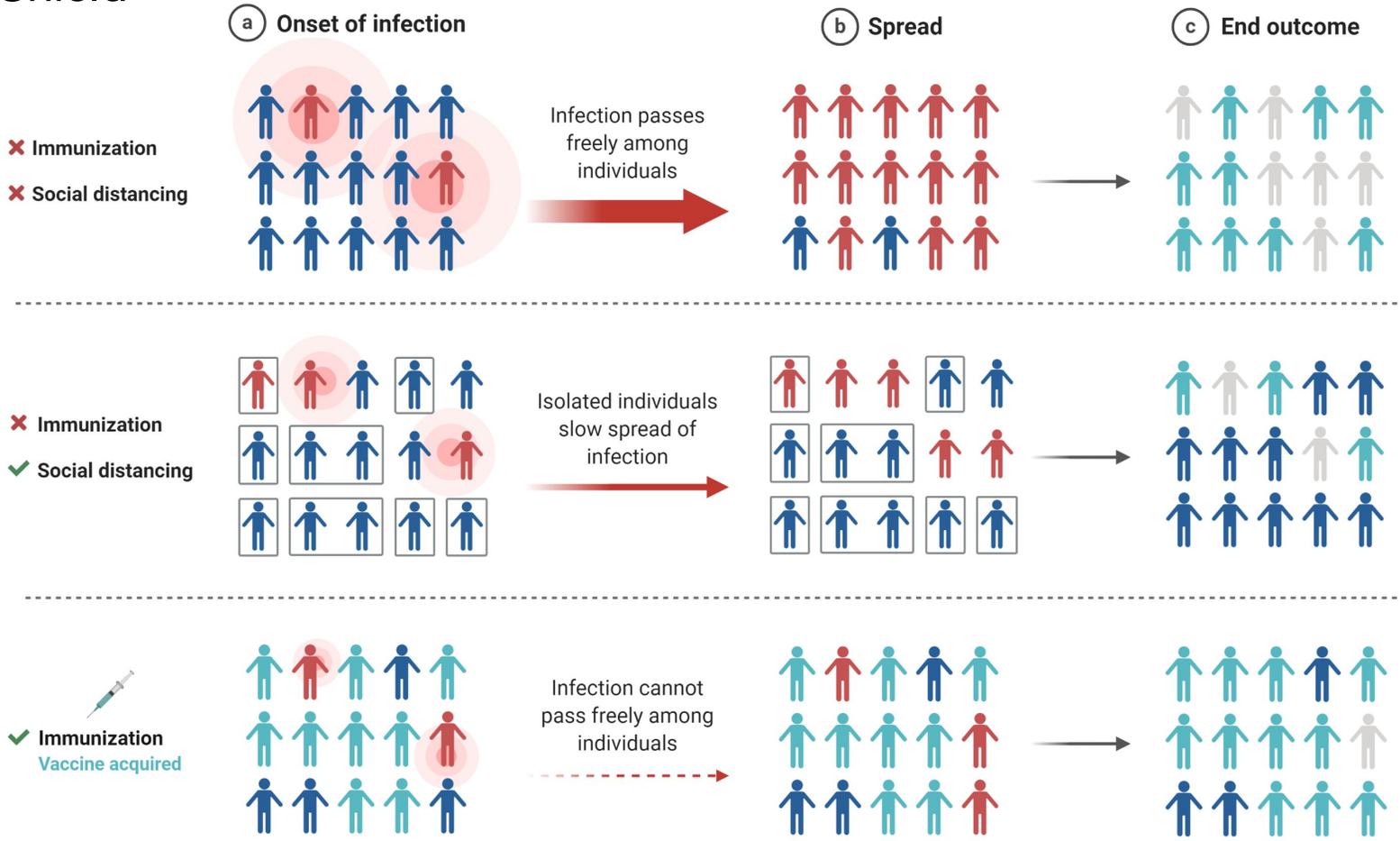
Adapted from CDC / The Economist

Principles of ~~Social Distancing~~ Physical Shield

HERD IMMUNITY & SOCIAL DISTANCING



From
Dr. Akiko Iwasaki (Yale)



Hope for the future: Testing, Antivirals & Vaccines

- Physical distancing (not Social!) will help delay cases and not overwhelm our ICUs
- We need more tests! 2 kinds of tests
- Antivirals and other therapies
- Vaccines - still a year or more away but probably feasible and necessary

What is immunity?

- Your immune system has 2 major weapons.
- One (the Innate immune system) is fast and does not remember the enemy, but gives data to the second (the Adaptive immune system) which makes awesome weapons (killer cells and antibodies [basically guided missiles]) and remember the enemy forever.
- The innate immune system can kill indiscriminately. The Cytokine Storm caused by lung macrophages may be a problem here.
- The Adaptive immune system needs 7-10 days to be fully functional the first time we see a new pathogen.
- Vaccines teach the Adaptive immune system (via the Innate) in a controlled way so that they are ready and can react fast to wipe out the really nasty pathogens (like Polio, whooping cough, scarlet fever, other things you never hear about anymore!)

Tests for SARS-CoV-2/COVID-19 and Potential Uses

Type of Test	Measure	Value	Beneficiary
 <p>Nucleic acid amplification test for viral RNA <i>(nasopharyngeal swab, oropharyngeal swab, sputum, bronchoalveolar lavage fluid, others)</i></p>	Current infection with SARS-CoV-2	<ul style="list-style-type: none"> • Inform individual of infection status so they can anticipate course of illness and take action to prevent transmission • Inform patient management and actions needed to prevent transmission • Inform actions needed to prevent transmission 	<ul style="list-style-type: none"> • Individual • Healthcare or long-term care facility • Public health
 <p>Antibody detection</p>	Past exposure to SARS-CoV-2	<ul style="list-style-type: none"> • Detect susceptible individuals (antibody negative) and those previously infected • Identify individuals with neutralizing antibodies • Facilitate contact tracing and surveillance 	<ul style="list-style-type: none"> • Identify those potentially immune to SARS-CoV-2 (if tests can detect protective immunity, individuals could be returned to work) • Healthcare facilities: Experimental therapy • Public health

FIG 1 Tests for SARS-CoV-2/COVID-19 and potential uses.

Not clear if antibodies = immunity yet

Vaccines and antivirals

- As of Thursday May 7, 90+ vaccines in development and testing
- Several companies testing antivirals and immune mediators for acutely ill
- Will this virus become seasonal like the other cold viruses and flu? Not known. SARS-CoV-1 disappeared.
- Will it mutate? Yes. But it mutates slower than the flu. https://www.thoracic.org/members/assemblies/sections/gg/journal-club/genomics_of_sars_cov_2.php
- Veterinary literature and the few studies available suggests immunity may last at least a year for many coronaviruses, and potentially longer.

Great questions

- Can the sun kill the virus? How about UV light? - UV light definitely but dangerous. Sun appears to be able to do so as well but probably takes an hour or so.
- What temperature kills the virus? Extended high temperatures (such as clothes dryers or for cooking) work well against most infectious agents.
- Is the grocery store or delivery safe? Yes, but if you have elderly or vulnerable people in your care, please consider wiping down and washing items before bringing them in the home
- Are Ibuprofen/NSAIDs bad? Not certain/no evidence so far.
- What is plasma from convalescent (recovered) patients for? It contains antibodies to fight the virus

Great questions

- What is a titer? - a serial dilution of virus or antibody to virus helps us measure virus or antibody concentration. The more it can be diluted and still detected indicates how much was present in a sample. The reciprocal of a dilution is called a titer.
- What about lateral flow/dipstick tests like flu tests? Some are deployed but low sensitivity and accuracy
- What about permanent lung damage? Not known yet.