COVID-19: What to Tell Your Friends and Family

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January 27, 2021

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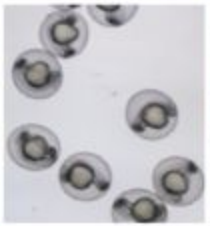


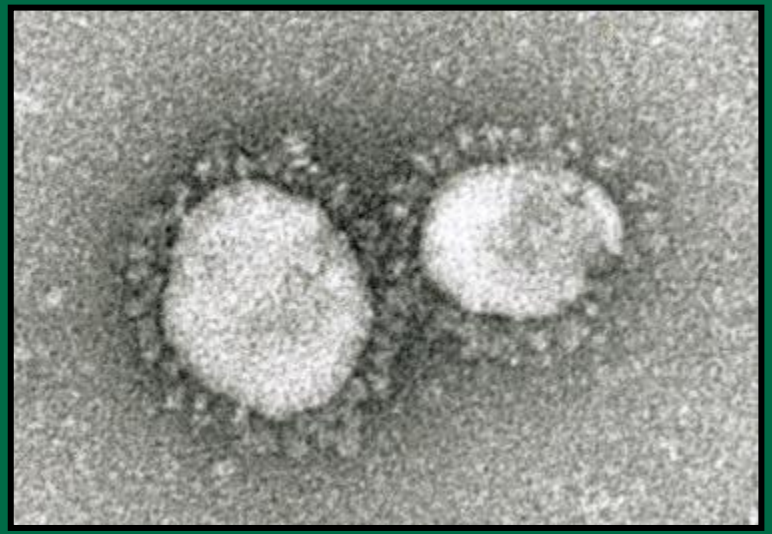

Financial Disclosures

I have no financial disclosures relevant to this presentation

Outline

- **Epidemiology of COVID-19 (SARS-CoV-2)**
- **Disease Transmission for COVID-19**
- **Myth Busting for COVID-19**
  - “If I test positive for COVID-19 but don’t have symptoms, then it’s likely a false negative test.”
  - “What’s the big deal, it’s no different than the flu.”
  - “There is a high survival rate, why should we care?”
  - “I don’t need to get a vaccine, I can rely on others getting it.”
  - “If I get my vaccine, I don’t have to wear a mask anymore”

COVID-19 (SARS-CoV-2) Epidemiology



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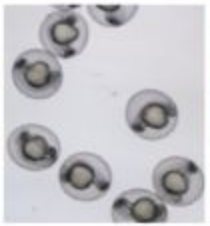


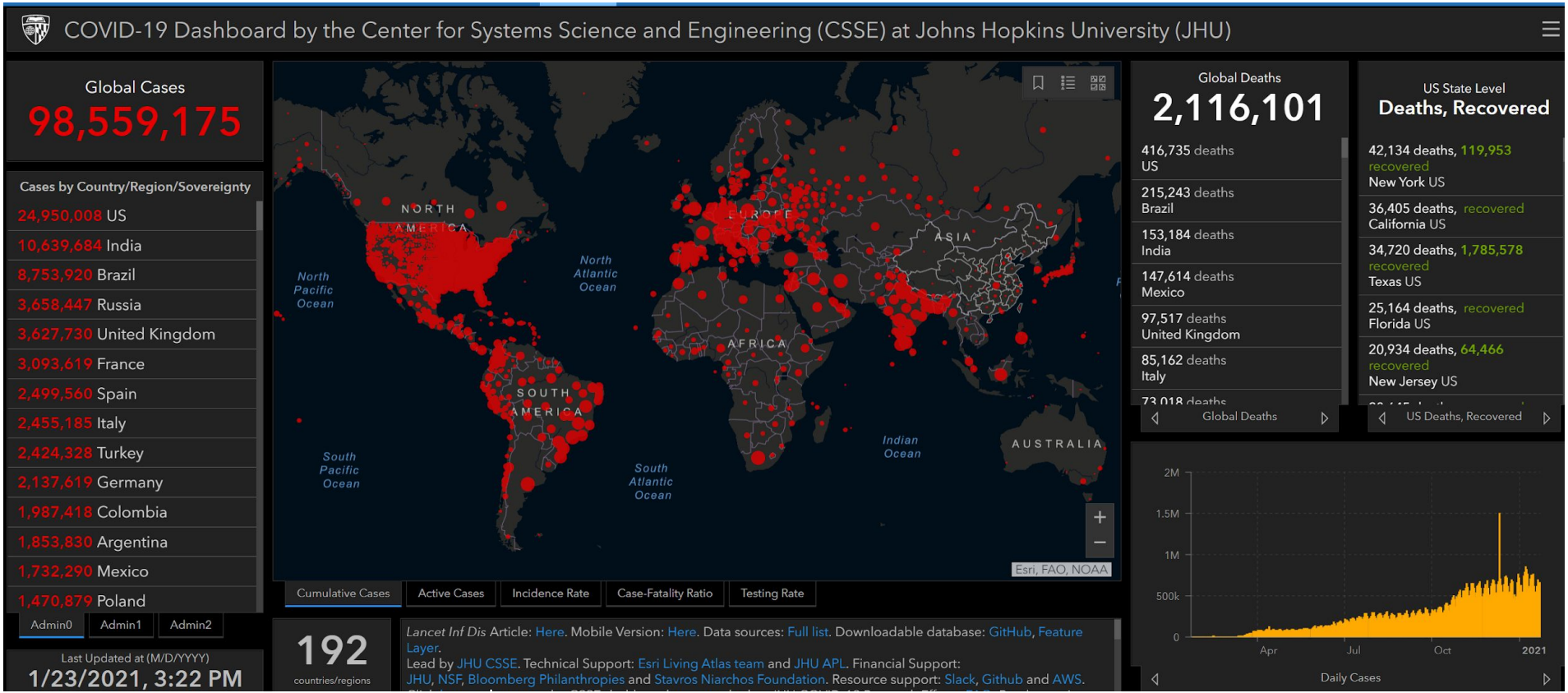

https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html

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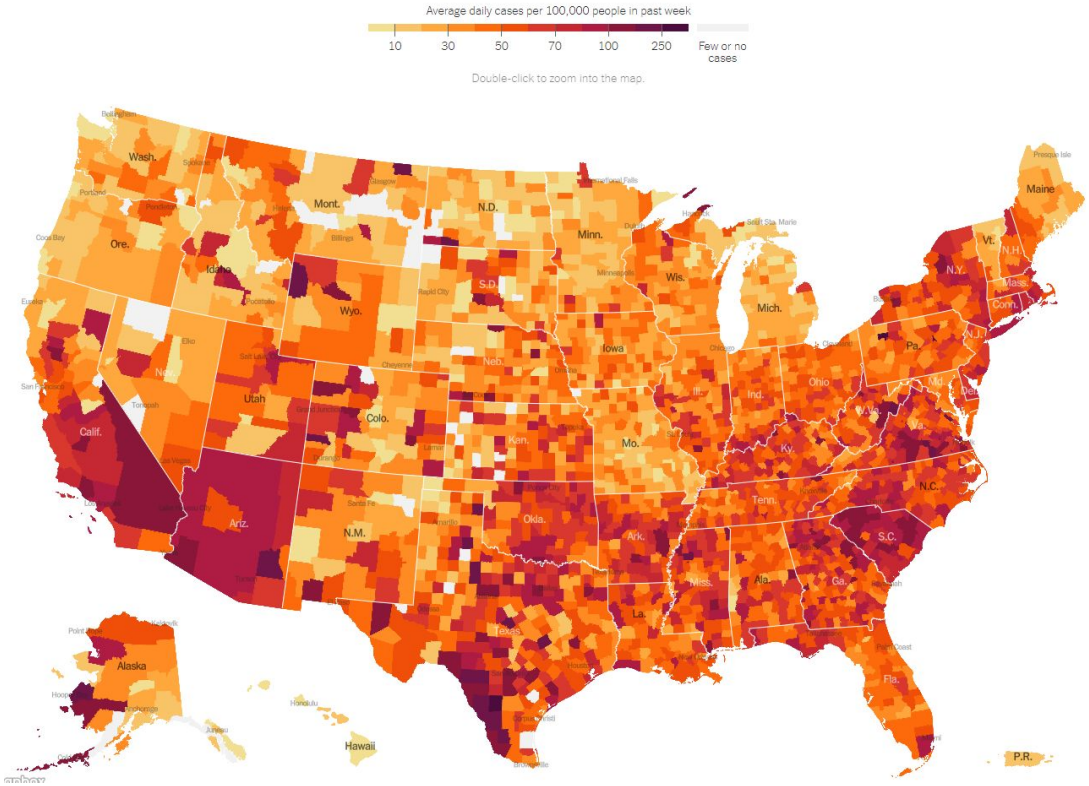

Updated January 23, 2021, 2:08 P.M. E.T.

Leer en español

	TOTAL REPORTED	ON JAN. 22	14-DAY CHANGE
Cases	24.9 million+	191,912	-30% ↘
Deaths	415,686	3,734	Flat →
Hospitalized		116,264	-5% →

Day with reporting anomaly. Hospitalization data from the Covid Tracking Project; 14-day change trends use 7-day averages.

https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html

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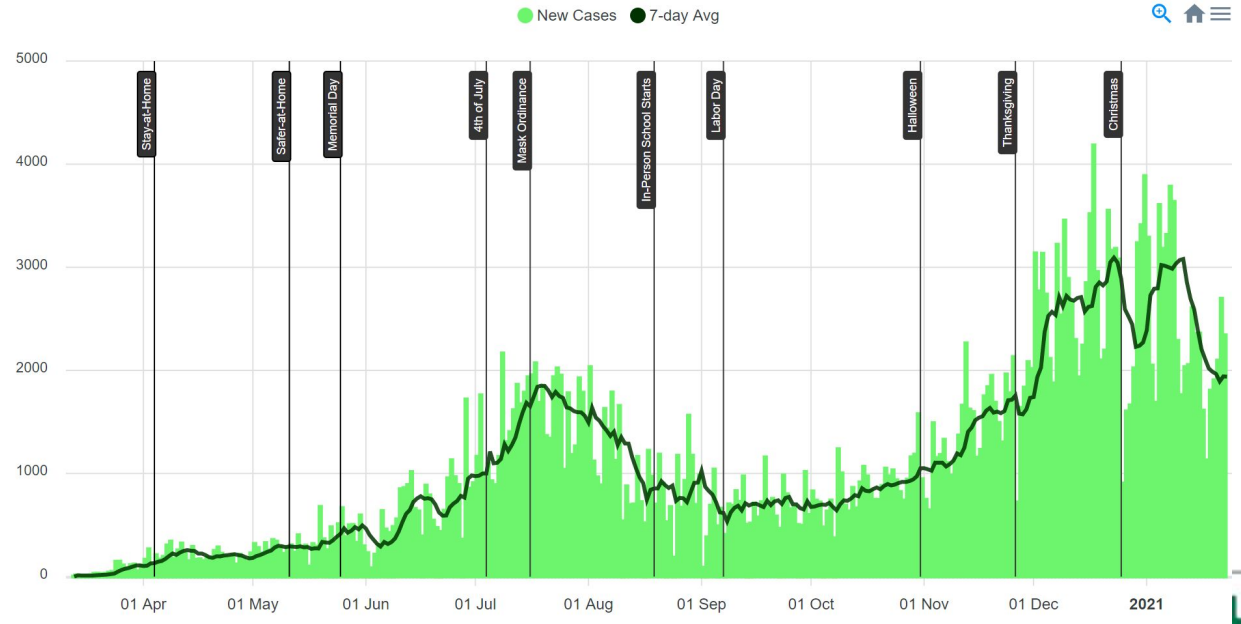
Alabama Case Burden as of January 23, 2021

439,442	6,657	+3,355	233,211
348,017 Conf. + 91,425 Prob.	5,464 Conf. + 1,193 Prob.	2,340 Conf. + 1,015 Prob.	
Total Cases	Total Deaths	Cases Yesterday	Recovered
2,078,488 Total +12,137 Yesterday Tests Reported	0 Allotted → 223,887 Administered Vaccinations	44,597 Cases 248,514 Tested Last 14 Days	40,514 Total 2,258 Current → Hospitalizations



https://www.bamatracker.com/

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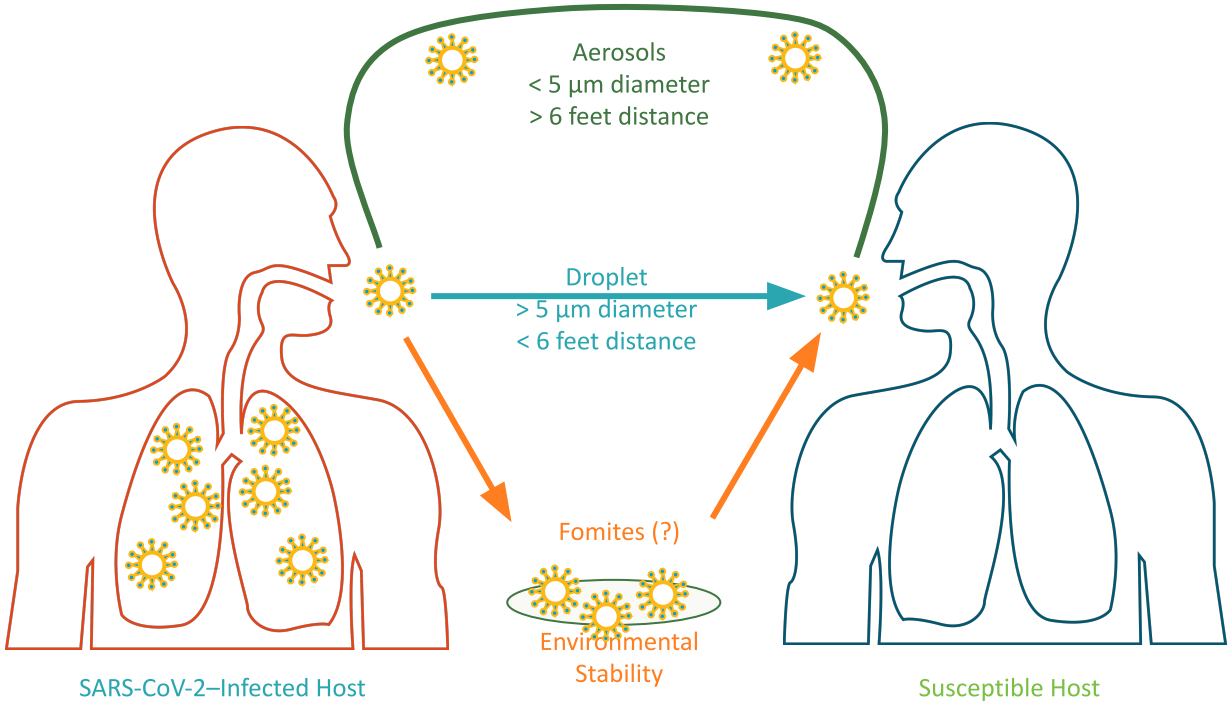
Transmission Dynamics and COVID-19

Proposed Routes of SARS-CoV-2 Transmission



Galbadage. Front Public Health. 2020;8:163.

Slide credit: clinicaloptions.com

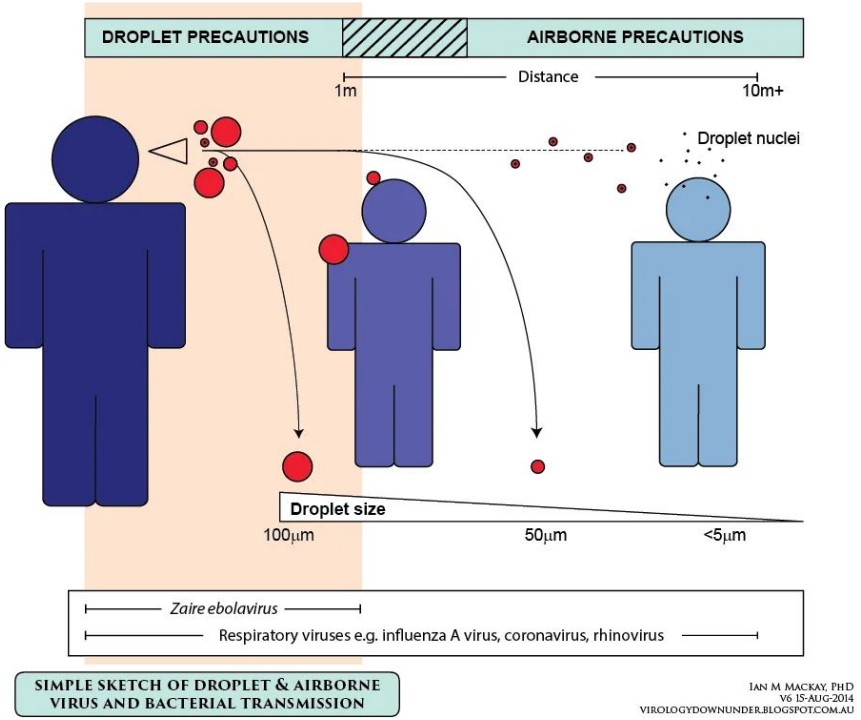
Airborne, aerosols, droplets, nuclei

Aerosols (an over-arching term)- includes a range of particles

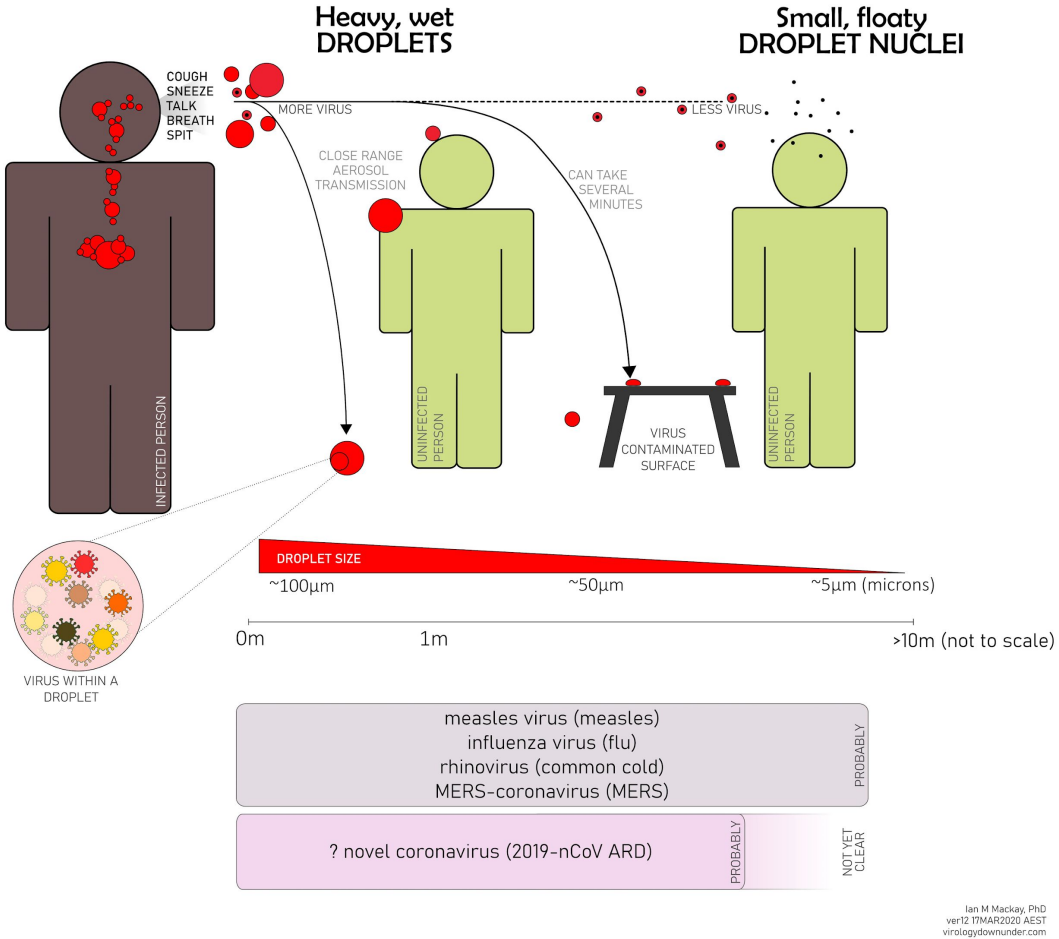
Droplets: larger than 5-10 microns (a micron [μm]; about 1/10 the width of a human hair) fall to the ground within seconds of impact on another surface without evaporating

Droplet nuclei: remain suspended in the air and evaporate quickly, leaving behind particles consisting of proteins, salts, and suspended viruses

- can remain airborne for hours
- It is only the droplet nuclei that are capable of riding the air currents through a hospital, etc



https://virologydownunder.com/flight-of-the-aerosol/



Size of particles and distance expelled is variable and depends on many factors:

- Size distribution
- Propulsive force generated by the individual
- Relative humidity
- Evaporation level
- Settling velocity
- Direction of airflow
- Air changes/hour
- Temperature
- crowding

https://virologydownunder.com/flight-of-the-aerosol/

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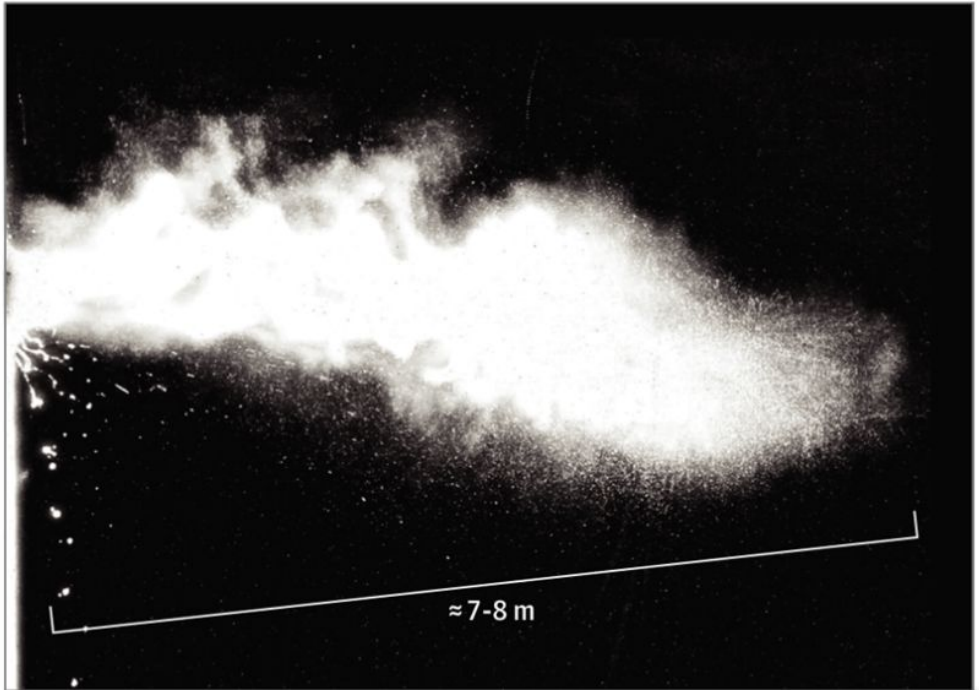
Concern: Is 6 feet enough?

Viruses are released during exhalation, talking, and coughing in microdroplets small enough to remain in the air 1-2 M from an infected individual

If SARS-CoV-2 primarily carried by aerosols that remain suspended in the air for prolonged periods of time, then:

- medical masks would be inadequate
- face shields would only provide partial protection
- 6 feet separation would not be enough

Figure. Multiphase Turbulent Gas Cloud From a Human Sneeze



Outbreaks likely associated with Droplet transmission

- **25 close contacts sitting within 2m of symptomatic index case and presymptomatic case, multiple exposed flight members, 350 passengers on board the airplane during 15 hour flight**
  - No evidence of transmission of SARS-CoV-2

Schwartz KL, Murti M, Finkelstein M, Leis J, Fitzgerald-Husek A, Bourns L, et al. Lack of COVID-19 transmission on an international flight2020 24 2020. Available from: https://www.cmaj.ca/content/192/7/E171/tab-e-letters#lack-of-covid-19-transmission-on-an-international-flight.

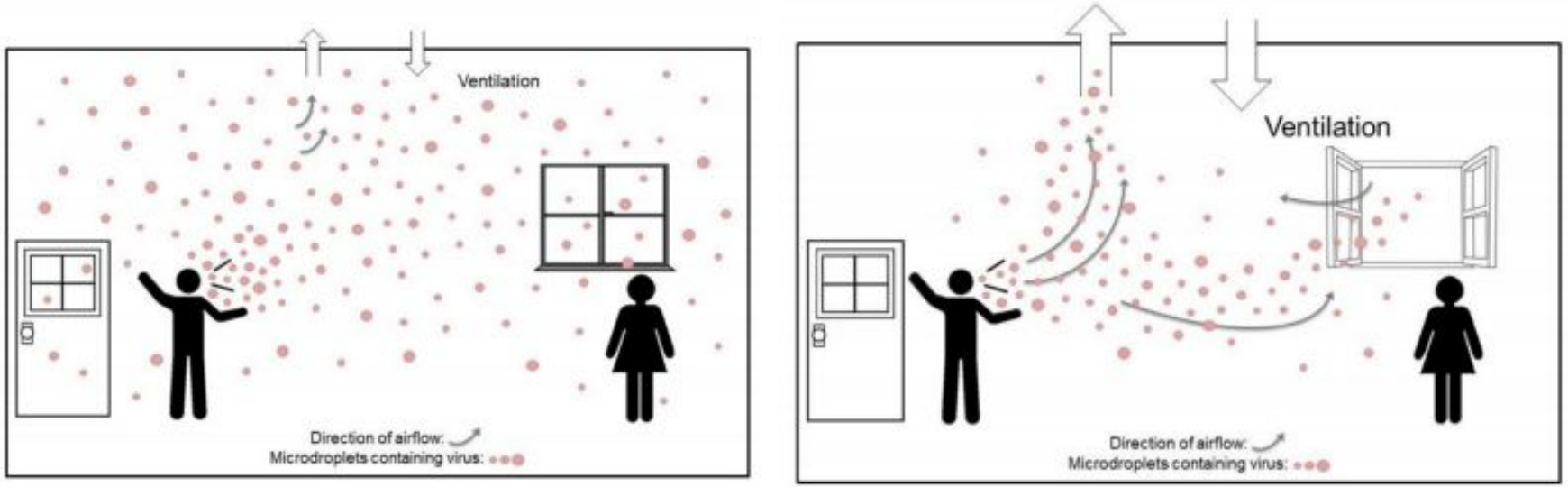
- **41 HCW exposed to aerosol generating procedures for at least 10 minutes, <2m from patient. 85% wore surgical masks, 15% worse N95s.**
  - No transmission events of SARS-CoV-2 with repetitive testing of all HCW

Ng K, Poon BH, Kiat Puar TH, Shan Quah JL, Loh WJ, Wong YJ, et al. COVID-19 and the risk to health care workers: a case report. Ann Intern Med. 2020; 172(11):766–767.

- **48 person nosocomial outbreak in pediatric dialysis unit**
  - 7 HCW, 3 patients, 1 accompanying person infected – all had 15 minute direct contact or exposure within 2m without any PPE
  - Remaining contacts who shared indoor environment without close contact or distance >2m but without any PPE, none tested positive for SARS-CoV-2

Schwierzeck V, Konig JC, Kuhn J, Mellmann A, Correa-Martinez CL, Omran H, et al. First reported nosocomial outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in a pediatric dialysis unit. Clin Infect Dis. 2020;ciaa491. [published online ahead of print, 2020 Apr 27].

Concern: Shared environments may allow for airborne transmission



Distribution of respiratory microdroplets in an indoor environment with inadequate and adequate ventilation

Clinical Infectious Diseases, ciaa939, https://doi.org/10.1093/cid/ciaa939

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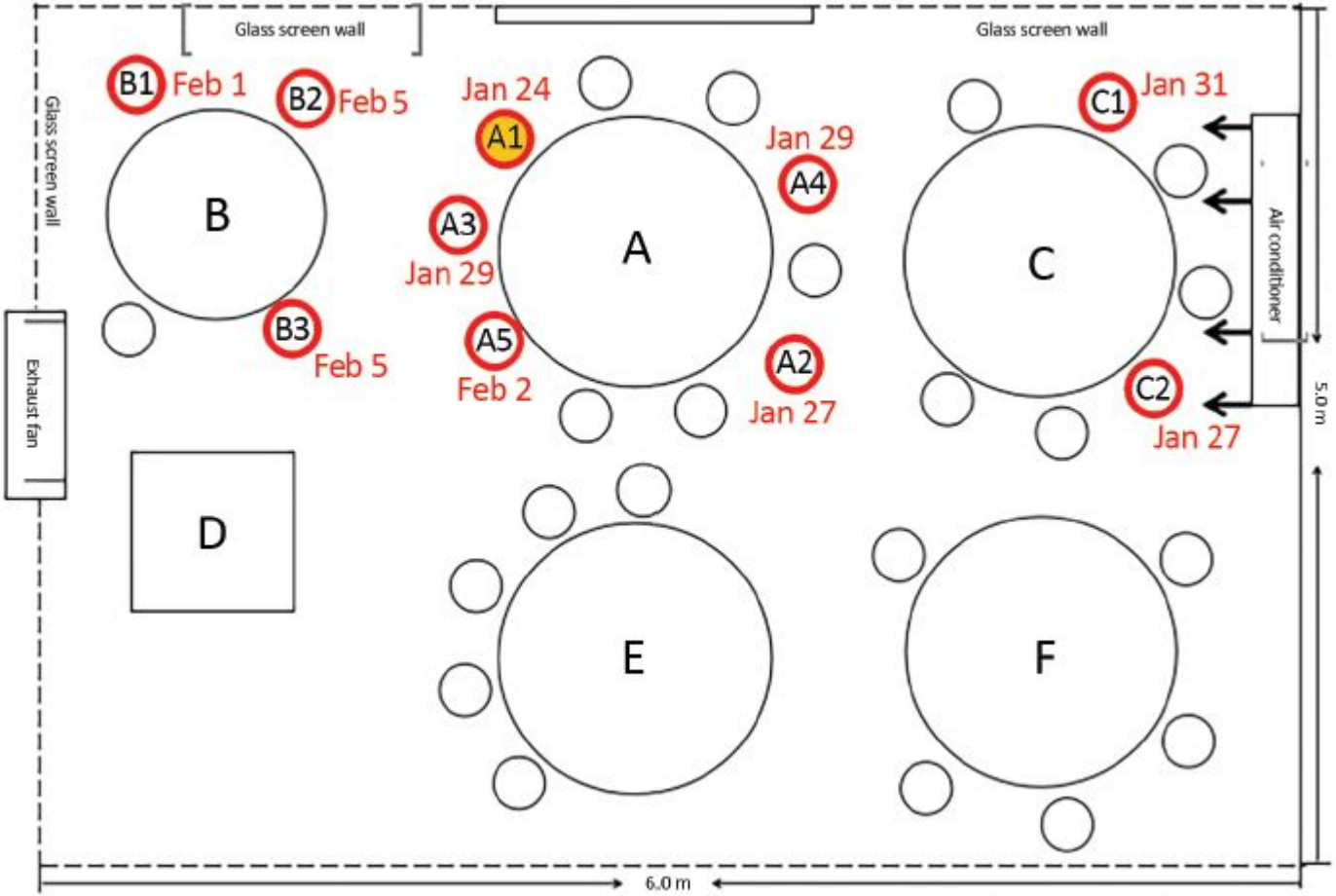

Lu J, Gu J, Li K, et al. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020. *Emerging Infectious Diseases*. 2020;26(7):1628-1631. doi:10.3201/eid2607.200764.

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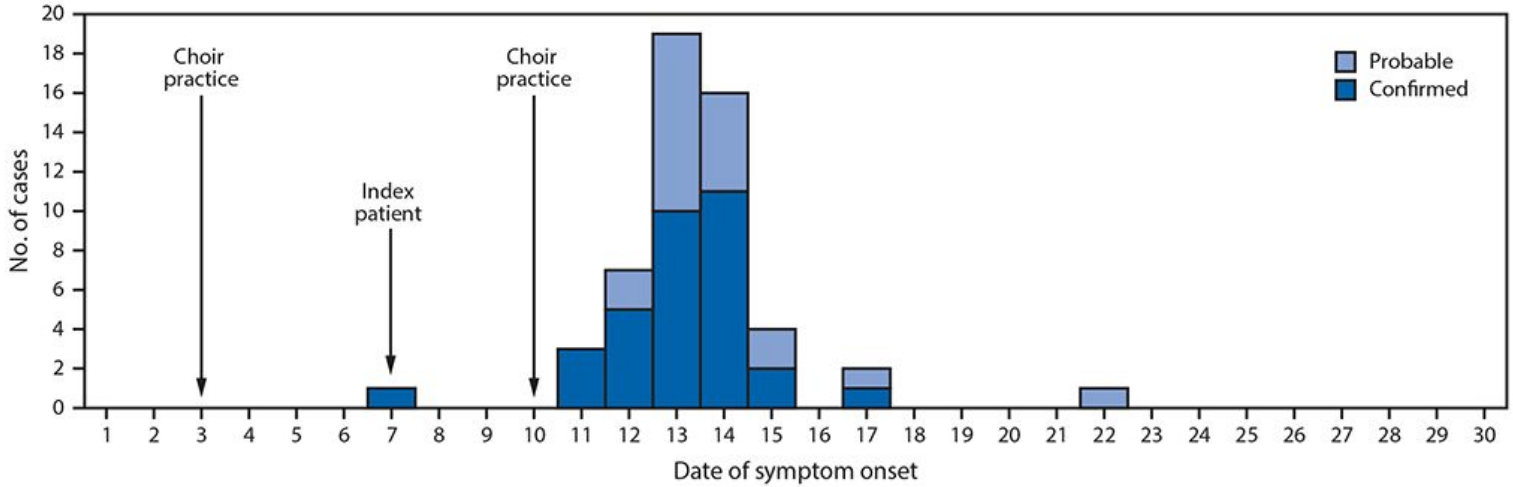
Super-spreader events

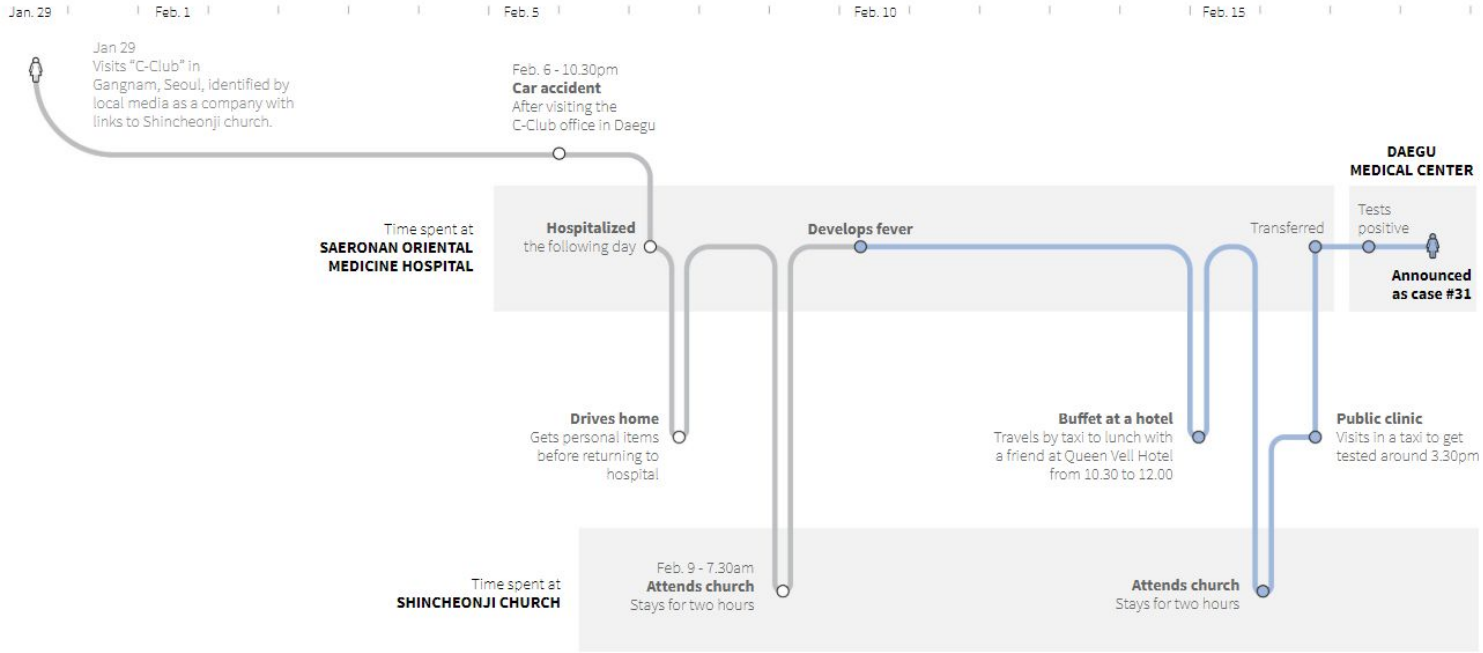
FIGURE. Confirmed* and probable† cases of COVID-19 associated with two choir practices, by date of symptom onset (N = 53) — Skagit County, Washington, March 2020



2.5 hour practice; 6 rows of 20 chairs, spaced 6-10 inches apart. High noted secondary attack rate (53% confirmed, 87% confirmed and probably cases)

https://www.cdc.gov/mmwr/volumes/69/wr/mm6919e6.htm#F1_down

Patient 31 in South Korea



1,160 contacts through multiple venues by one patient

https://graphics.reuters.com/CHINA-HEALTH-SOUTHKOREA-CLUSTERS/0100B5G33SB/index.html

Airborne vs droplet

Droplet and airborne transmission are not really a dichotomy, more like a continuum with many factors

Small Particle Aerosol Transmission

Spread when concentrated in poorly ventilated spaces or very large amounts

True Airborne pathogens:

Measles: R0 = 12-18, household attack rates >90%

Varicella: R0 = 10, household attack rates = 85%

TB: R0 = 10, household attack rates = 50%

COVID:

R0= 2.3, household attack rates = 10.5%

Preventing COVID-19 Transmission

Physical distancing, face masks, and face shields

	Studies and participants	Relative effect (95% CI)	Anticipated absolute effect (95% CI), eg, chance of viral infection or transmission		Difference (95% CI)	Certainty*	What happens (standardised GRADE terminology)[29]
			Comparison group	Intervention group			
Physical distance ≥1 m *vs* <1 m	Nine adjusted studies (n=7782); 29 unadjusted studies (n=10736)	aOR 0·18 (0·09 to 0·38); unadjusted RR 0·30 (95% CI 0·20 to 0·44)	Shorter distance, 12·8%	Further distance, 2·6% (1·3 to 5·3)	−10·2% (−11·5 to −7·5)	Moderate†	A physical distance of more than 1 m probably results in a large reduction in virus infection; for every 1 m further away in distancing, the relative effect might increase 2·02 times
Face mask *vs* no face mask	Ten adjusted studies (n=2647); 29 unadjusted studies (n=10170)	aOR 0·15 (0·07 to 0·34); unadjusted RR 0·34 (95% CI 0·26 to 0·45)	No face mask, 17·4%	Face mask, 3·1% (1·5 to 6·7)	−14·3% (−15·9 to −10·7)	Low‡	Medical or surgical face masks might result in a large reduction in virus infection; N95 respirators might be associated with a larger reduction in risk compared with surgical or similar masks§
Eye protection (faceshield, goggles) *vs* no eye protection	13 unadjusted studies (n=3713)	Unadjusted RR 0·34 (0·22 to 0·52)¶	No eye protection, 16·0%	Eye protection, 5·5% (3·6 to 8·5)	−10·6% (−12·5 to −7·7)	Low‖	Eye protection might result in a large reduction in virus infection

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31142-9/fulltext

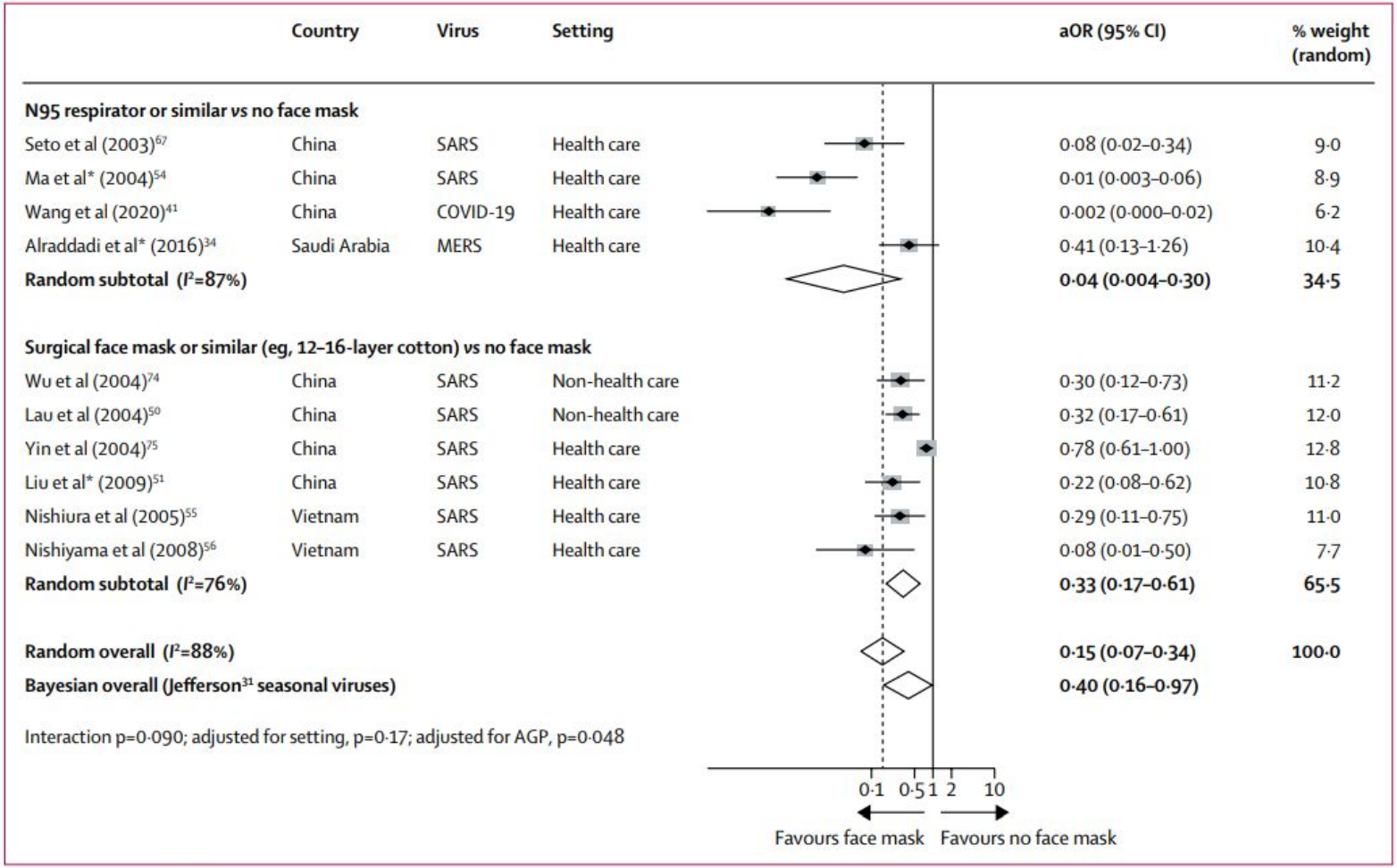
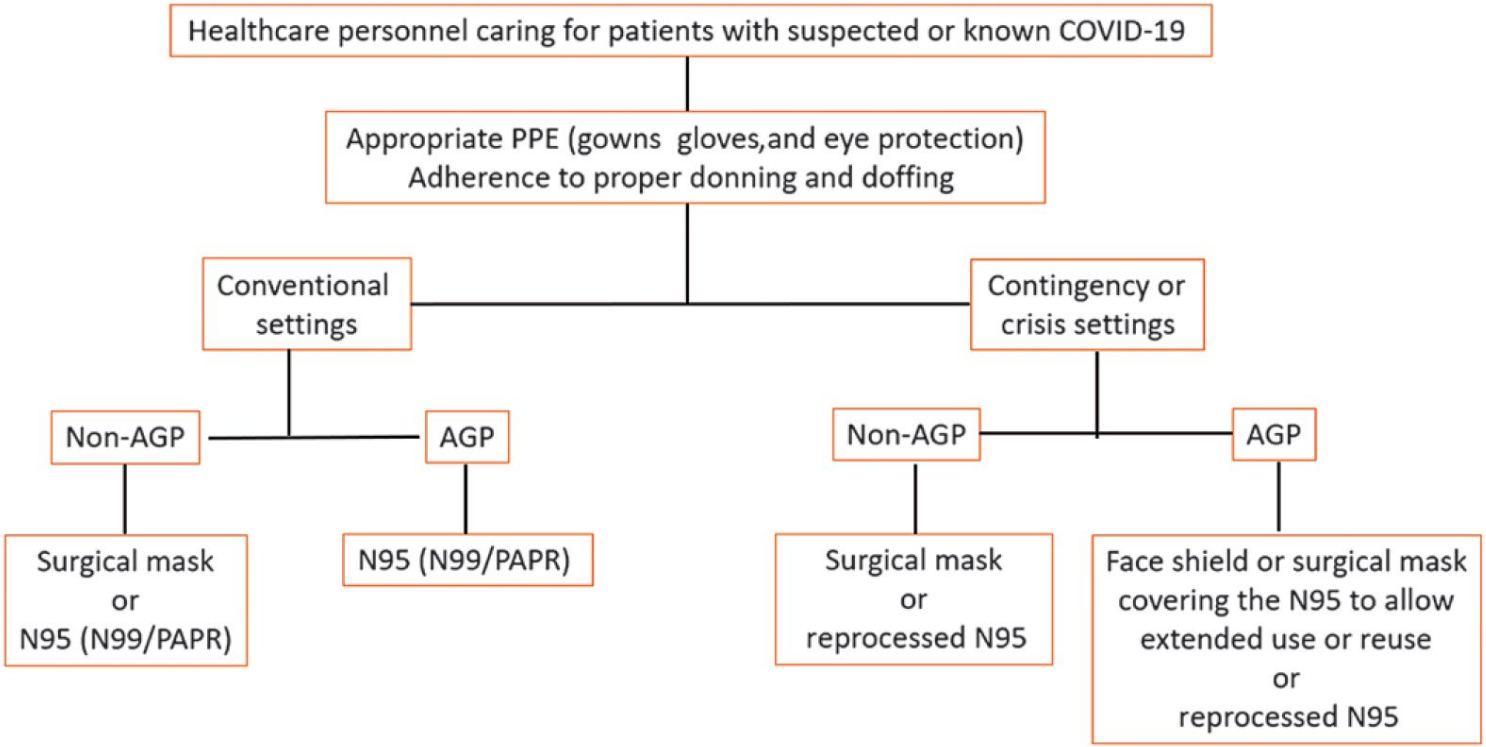


Figure 5: **Forest plot showing adjusted estimates for the association of face mask use with viral infection causing COVID-19, SARS, or MERS**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. AGP=aerosol-generating procedures.
*Studies clearly reporting AGP.

Current IDSA Recommendations for PPE in care of patients with COVID-19



https://academic.oup.com/cid/article/doi/10.1093/cid/ciaa1063/5876809

AGPs and COVID-19

Definition of aerosol generating procedure: procedures that are considered to have a greater likelihood of producing aerosols compared to coughing

"*a significant research gap exists in the epidemiology of the risk of transmission of acute respiratory infections from patients undergoing aerosol generating procedures to healthcare workers, and clinical studies should be carefully planned to address specific questions around the risks of transmission in these settings*"

Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: A systematic review. PLoS One 2012; 7: e35797.

So, why N-95s for AGP?

No direct evidence on AGPs and rates of COVID-19 infection, based on observational studies for SARS

Table 4. Risk of Severe Acute Respiratory Syndrome Transmission to Healthcare Workers Exposed and Not Exposed to Aerosol-generating Procedure, and Aerosol-generating Procedures as Risk Factors for SARS Transmission

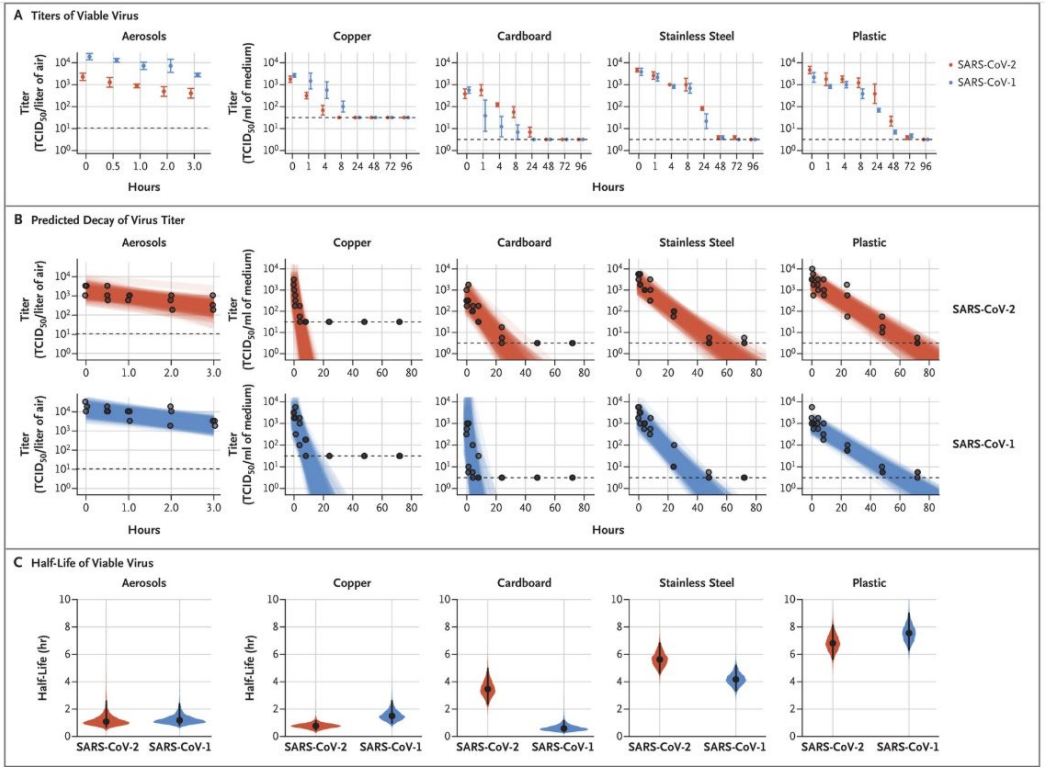
Type of Aerosol-generating Procedure	Odds Ratio	95% Confidence Interval
Tracheal intubation	6.6	2.3–18.9
Manipulation of oxygen mask	4.6	.6–32.5
Tracheotomy	4.2	1.5–11.5
Manipulation of bilevel positive airway pressure mask	4.2	.6–27.4
Suction before intubation	3.5	.5– 24.6
Noninvasive ventilation	3.1	1.4–7.2
Manual ventilation before intubation	2.8	1.3–6.4
Collection of sputum sample	2.7	.9–8.2
Defibrillation	2.5	.1–43.9
Bronchoscopy	1.9	.2–14.2
Chest compressions	1.4	.2–11.2
Insertion of nasogastric tube	1.2	.4–4.0

Adapted from [32].
Abbreviation: SARS, severe acute respiratory syndrome.

https://academic.oup.com/cid/article/doi/10.1093/cid/ciaa1063/5876809

Viability of SARS-CoV-2 in the Air

- Experimental conditions: use of a collision nebulizer and drum to create an aerosolized environment



N Engl J Med 2020; 382:1564-1567; DOI: 10.1056/NEJMc2004973

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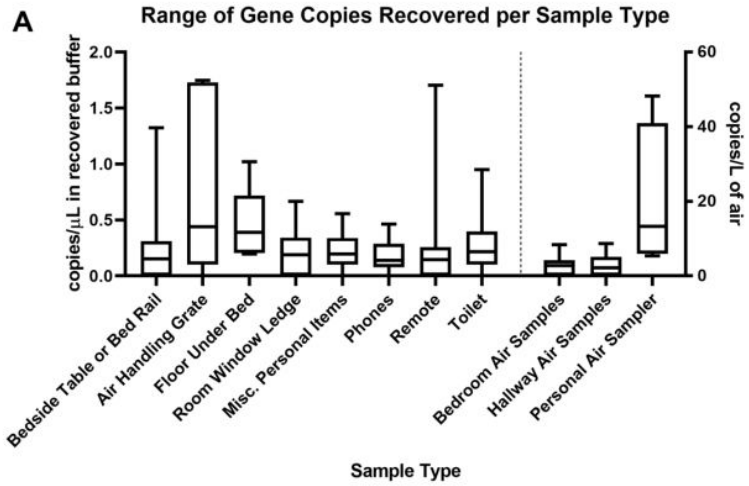
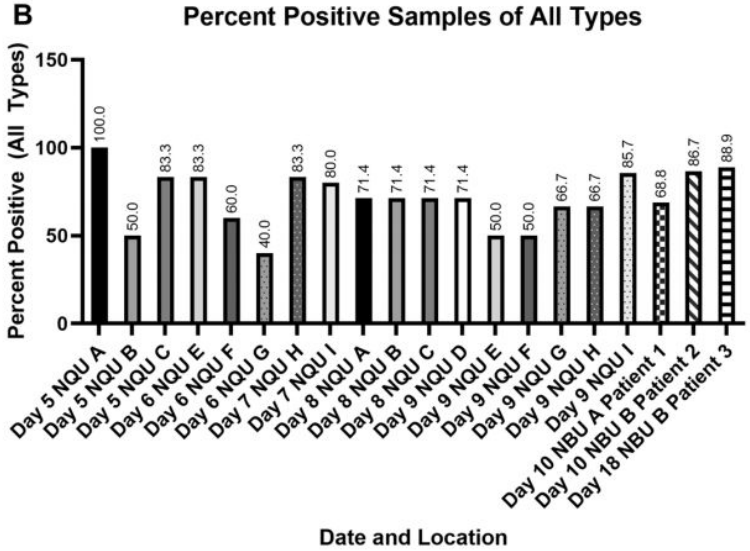
Airborne contamination within hospitals

13 individuals with COVID-19

- **163 samples from a variety of sources**
  - 121 (72%) had positive PCR
  - 63% of air samples were positive by PCR
  - Key point: viral cultivation could not be confirmed due to low concentrations of virus





https://www.nature.com/articles/s41598-020-69286-3.pdf

Viable SARS-CoV-2 in the air

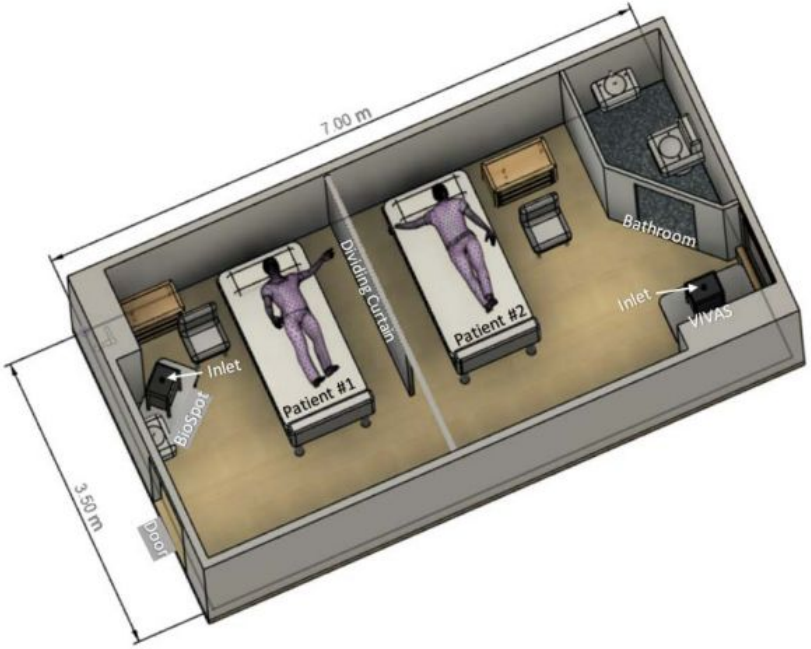


Table 3. Estimate of viable virus counts based on $TCID_{50}$ tests.

Sample ID	Virus genome equivalents/L of air[a]	$TCID_{50}$/100 µl	Viable virus count/L air
1-1 BioSpot	94	2.68E+04	74
1-2 BioSpot + HEPA	-	0	0
1-3 BioSpot	30	6.31E+03	18
2-1 VIVAS	44	1.00E+04	27
2-2 VIVA S+ HEPA	-	0	0
2-3 VIVAS	16	2.15E+03	6

[a]From Table 2.

Air samples were collected in the room of two COVID-19 patients

By using VIVAS air samplers that operate on a gentle water-vapor condensation principle, material was collected from room air and subjected to RT-qPCR and virus culture.

Viable virus was isolated from air samples collected 2 to 4.8m away from the patients.

The genome sequence of the SARS-CoV-2 strain isolated from the material collected by the air samplers was identical to that isolated from the NP swab from the patient

https://www.medrxiv.org/content/10.1101/2020.08.03.20167395v1.full.pdf

Conclusions about transmission of COVID-19

There is clear documented disease transmission through droplet particles

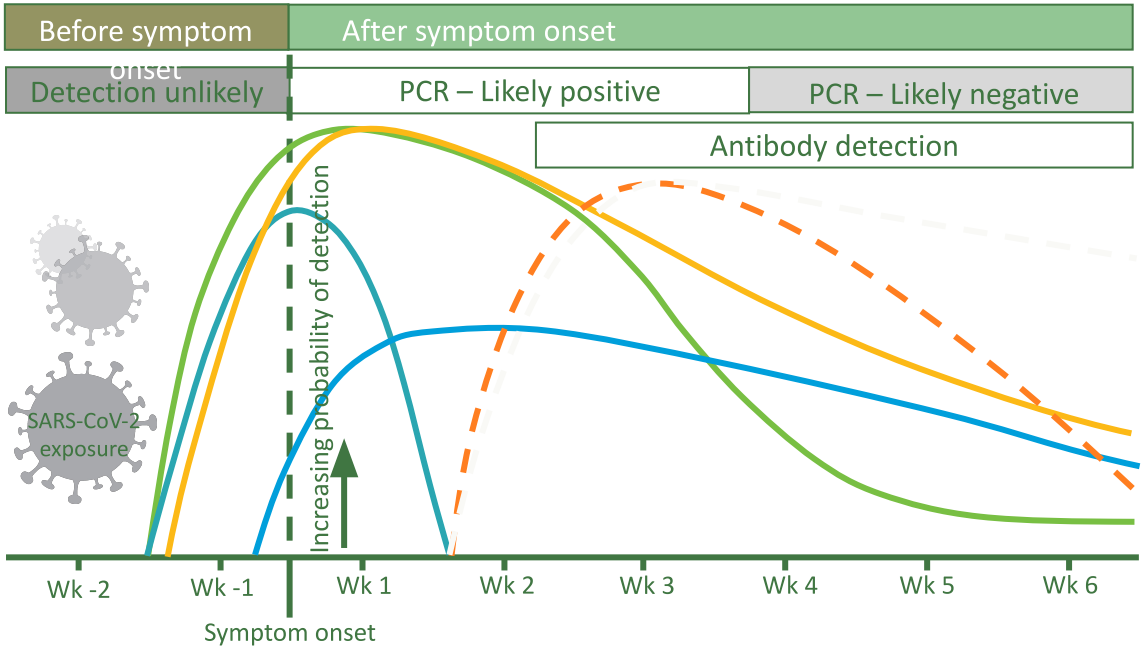
Aerosol transmission can occur in certain environments and are particularly dependent upon the viral load of the patient, air flow, and potentially created through certain procedures performed in the healthcare setting.

The relative importance of indirect transmission compared with direct is unknown, even under lockdown conditions. The World Health Organization (WHO) reports there is no conclusive evidence for fomite transmission.

WHO cautions that the consistent presence of fomites in the environment of infected cases suggests fomite transmission is an active means of transmission of the SARS-CoV-2 virus, as it is for other coronaviruses.

Myth 1: “If I test positive for COVID-19 but don’t have symptoms, then it’s likely a false negative test.”

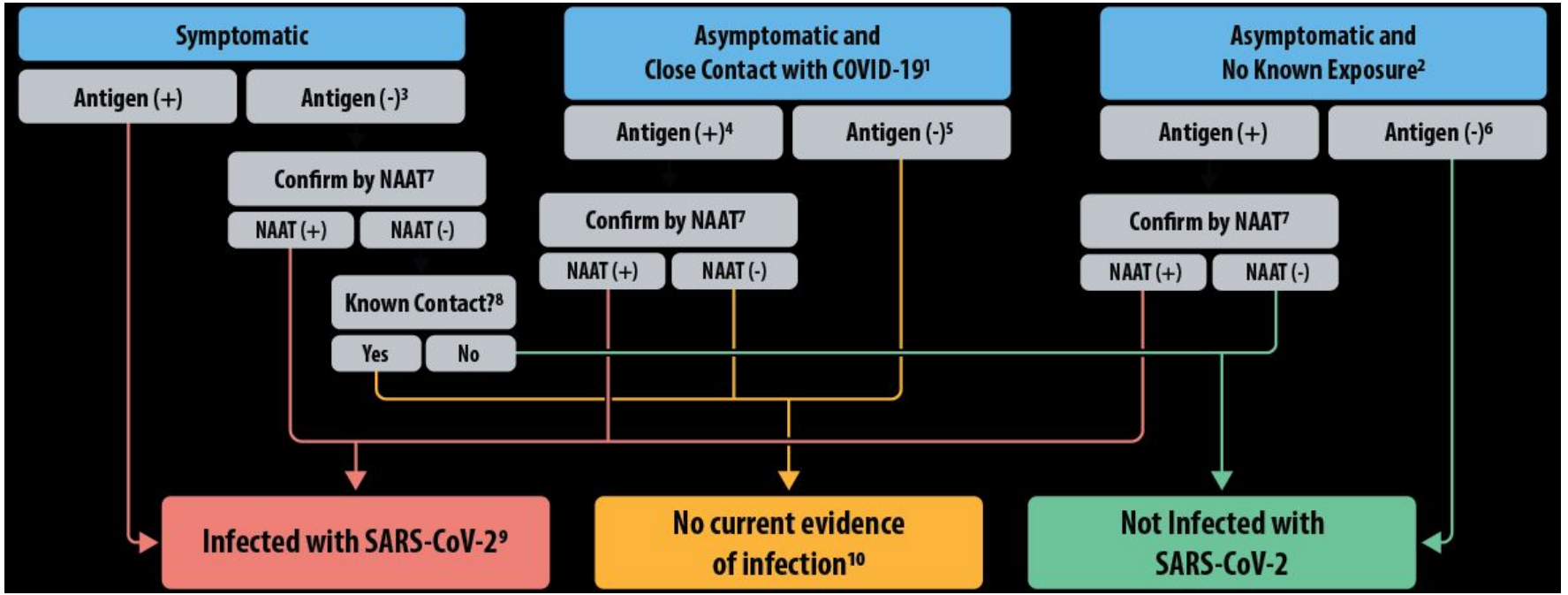
Temporal Considerations for Diagnosis of COVID-19



Viral RNA detectable in respiratory tract 2-3 days before symptoms appear

Slide credit: clinicaloptions.com

Antigen testing



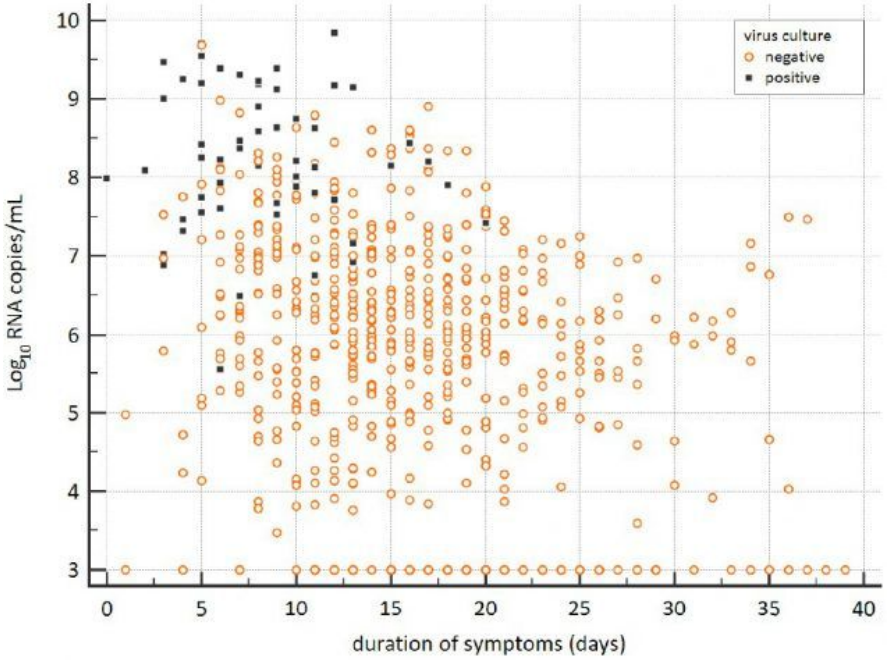
https://www.cdc.gov/coronavirus/2019-ncov/lab/resources/antigen-tests-guidelines.html

PCR vs culture

upper respiratory samples from a sample of severely ill patients, including some post -solid organ or -bone marrow transplant.

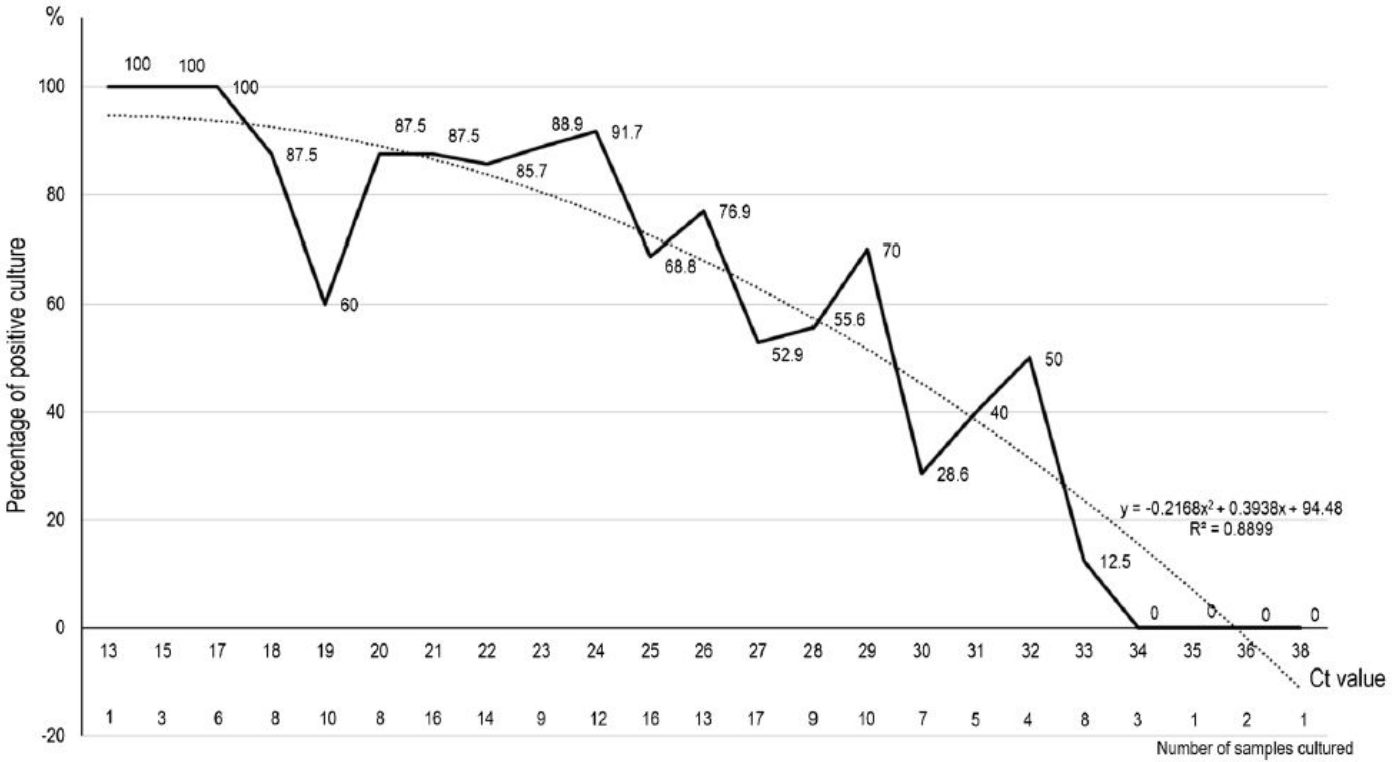
Black boxes represent samples that yielded replication-competent virus

Median duration of culturable virus = 8 days



Kampen et al, 2020

Viral CT values and Viral Culture



183 PCR samples were set up for culture, 129 led to virus isolation. No culture was positive if CT value was > 34

CT values should be interpreted with caution as they do not reflect a true viral load

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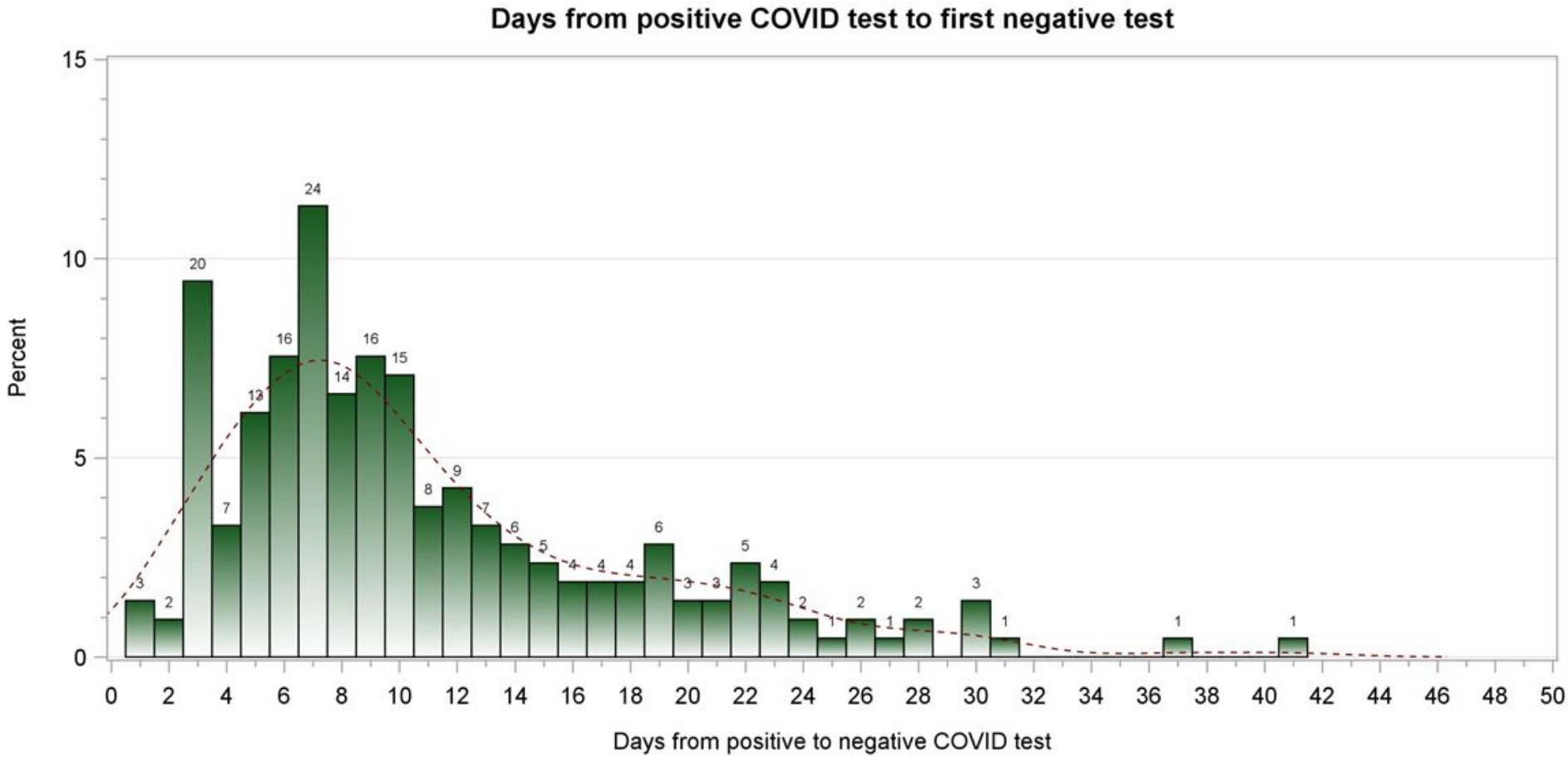

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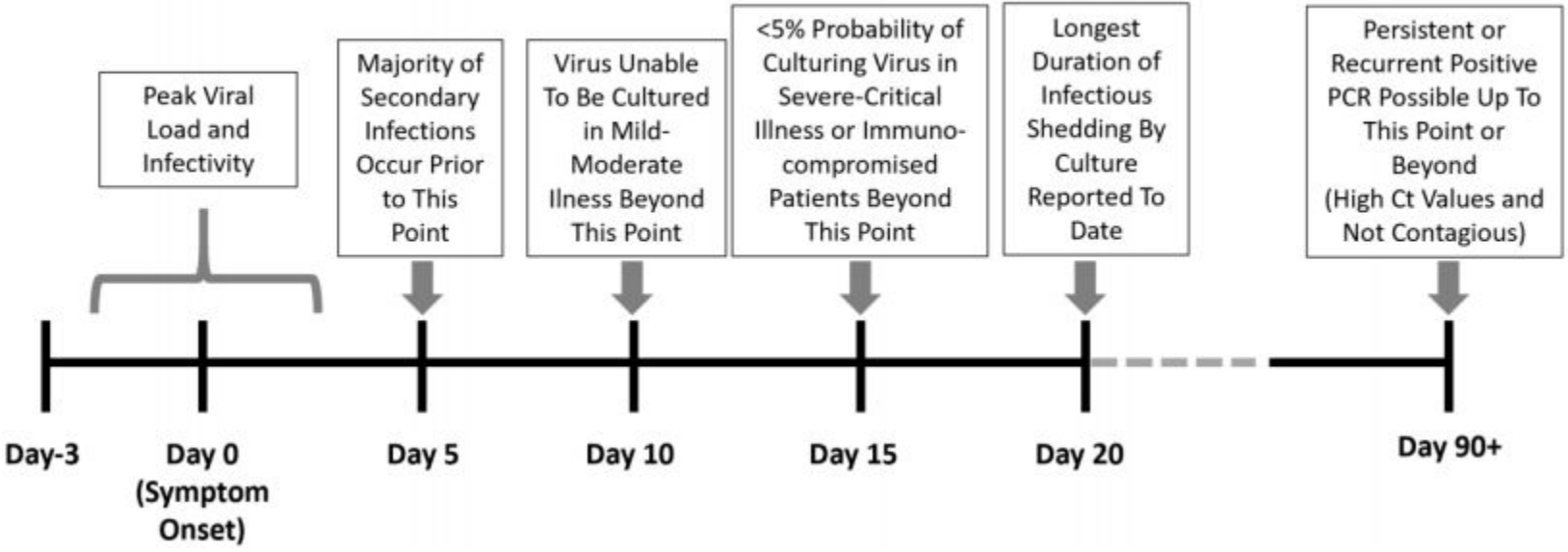

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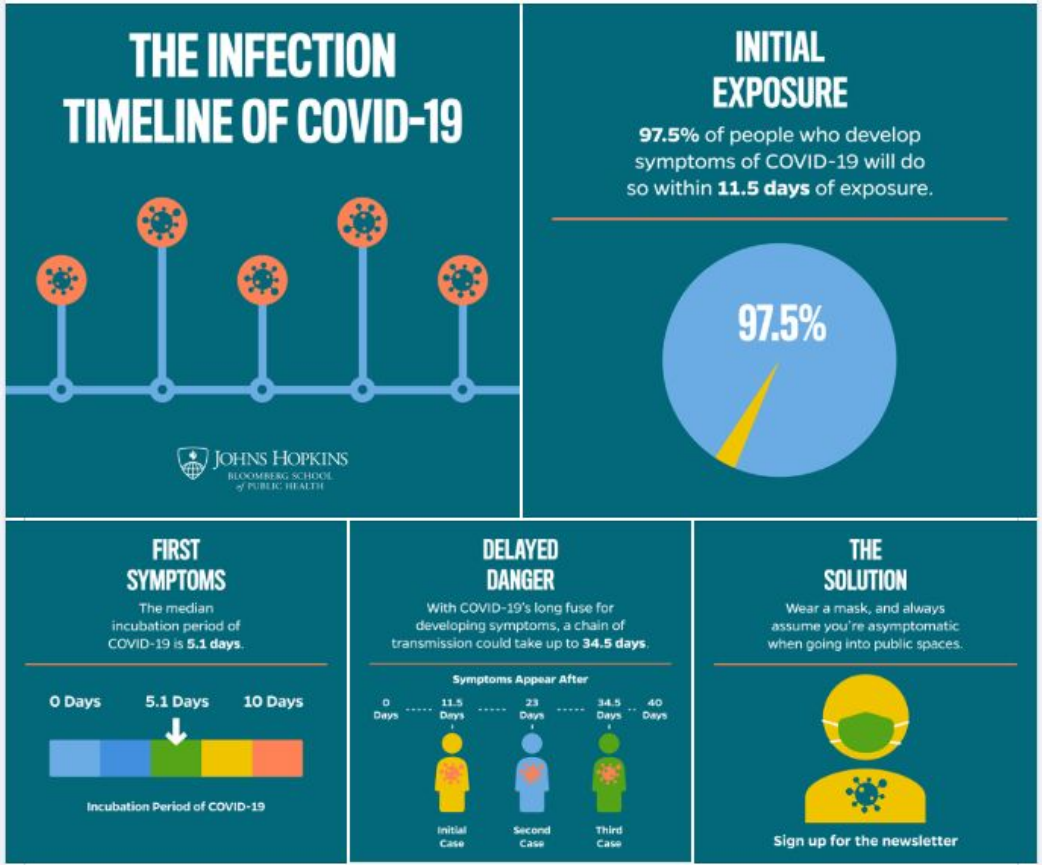
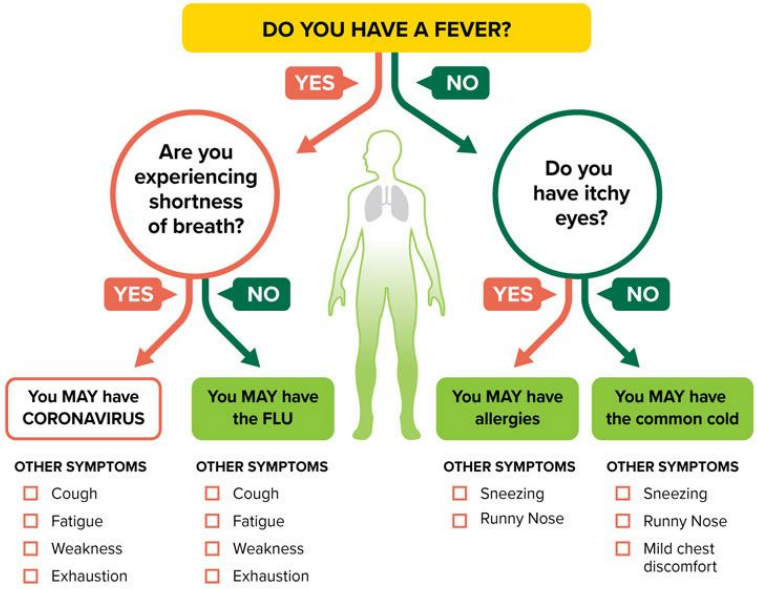
Myth #2: “What’s the big deal, it’s no different than the flu.”

Presentation of COVID-19



- Fever (83–99%)
- Cough (59–82%)
- Fatigue (44–70%)
- Anorexia (40–84%)
- Shortness of breath (31–40%)
- Sputum production (28–33%)
- Myalgia (11–35%)

Flu vs. Allergies vs. COVID



These are COMMON SYMPTOMS,
which may vary from person to person.
Only a doctor can give you a diagnosis.

uab.edu/coronavirus

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The University of Alabama at Birmingham

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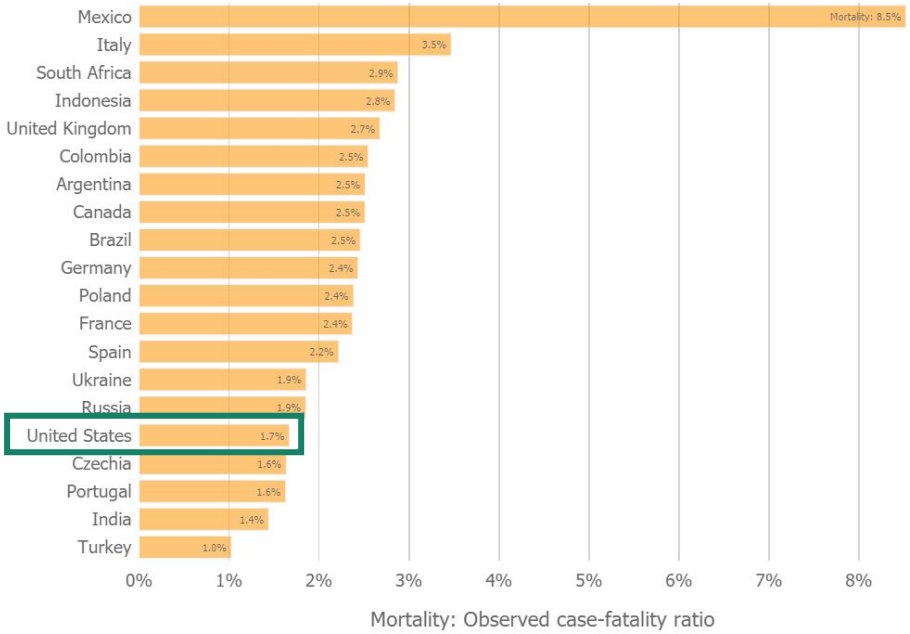
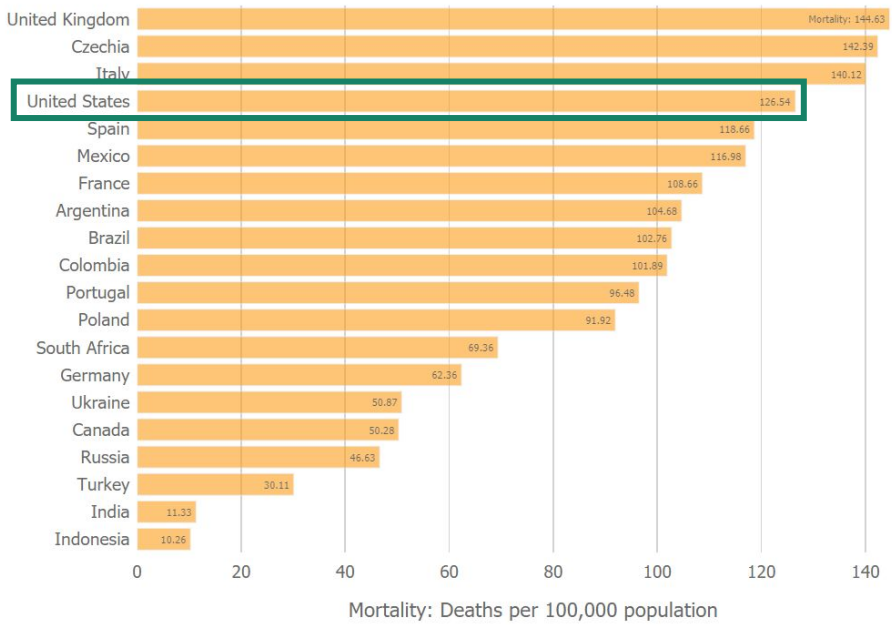
Flu vs COVID-19

- While symptoms are similar between cold and flu, COVID-19 spreads easily because very few people have immunity
- Few treatment options, unlike influenza
- The long term effects of COVID-19 are more significant than influenza:
  - 76% of >1700 COVID-19 patients from a hospital in Wuhan, China, were still not symptom-free at a 6-month follow-up
    - fatigue or muscle weakness
    - sleep difficulties
    - anxiety or depression

Myth 3: “There is a high survival rate, why should we care?”

Case Fatality Ratio vs deaths/100,000

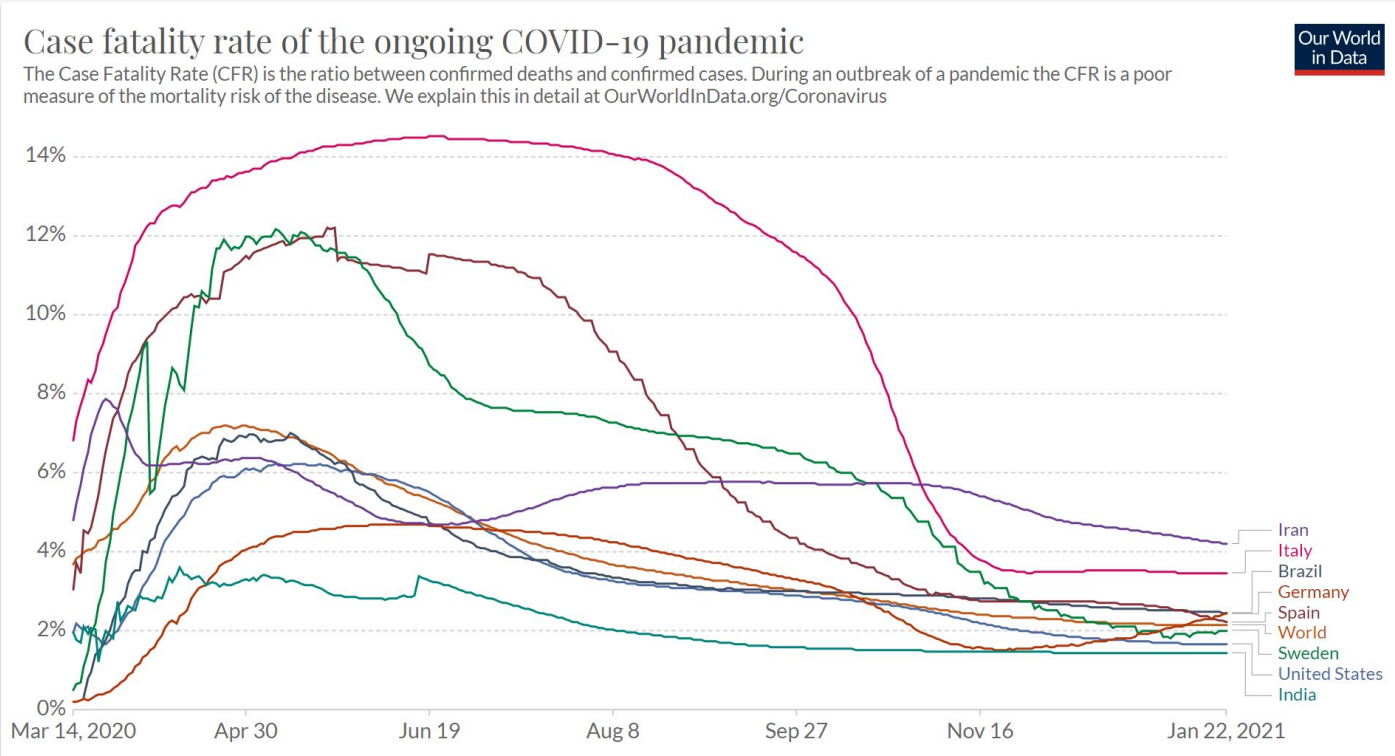




For the twenty countries currently most affected by COVID-19 worldwide, the charts show the number of deaths either per 100 confirmed cases (observed case-fatality ratio) or per 100,000 population (this represents a country's general population, with both confirmed cases and healthy people).

https://coronavirus.jhu.edu/data/mortality

Case Fatality Rate is affected by stress to healthcare system



https://ourworldindata.org/coronavirus-data-explorer

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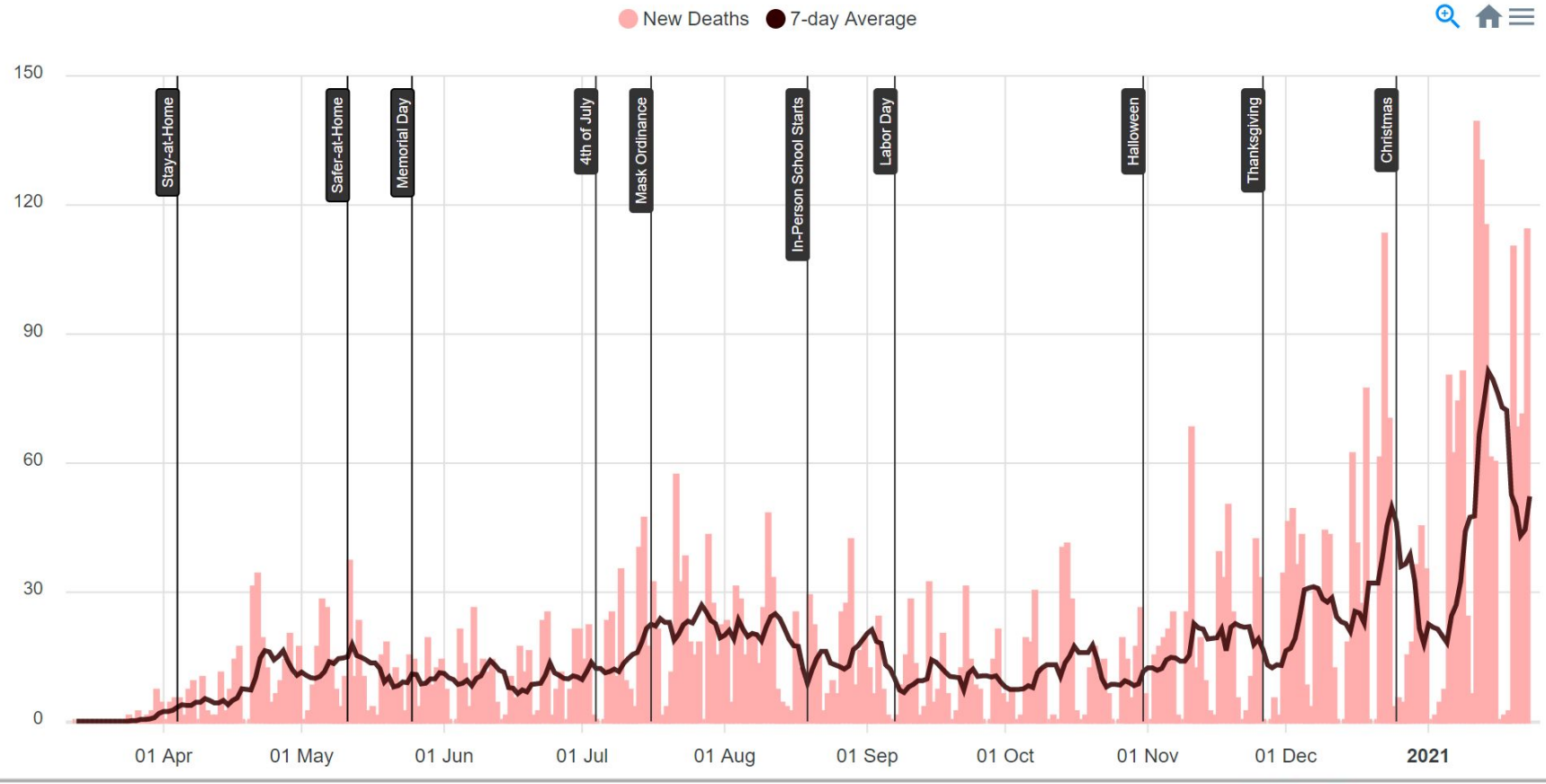

www.bamatracker.com

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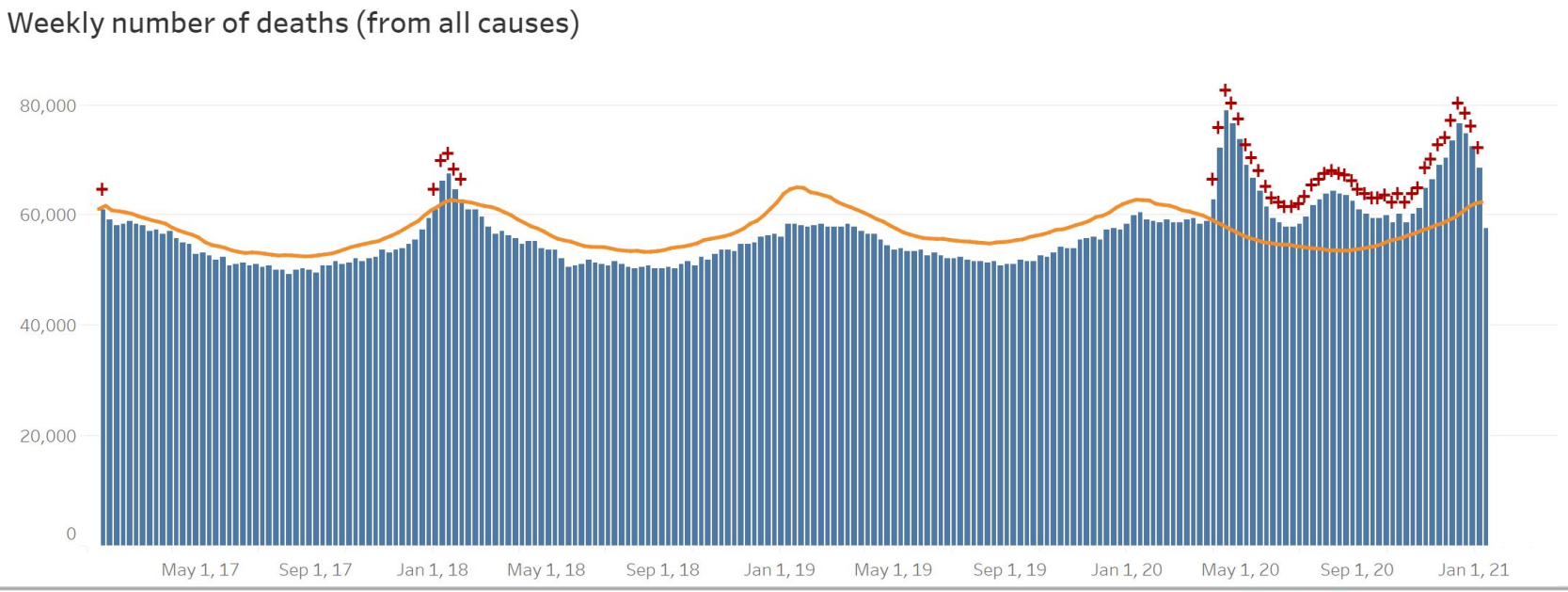
Excess mortality

+ indicates observed count above threshold
Predicted number of deaths from all causes
threshold for excess deaths



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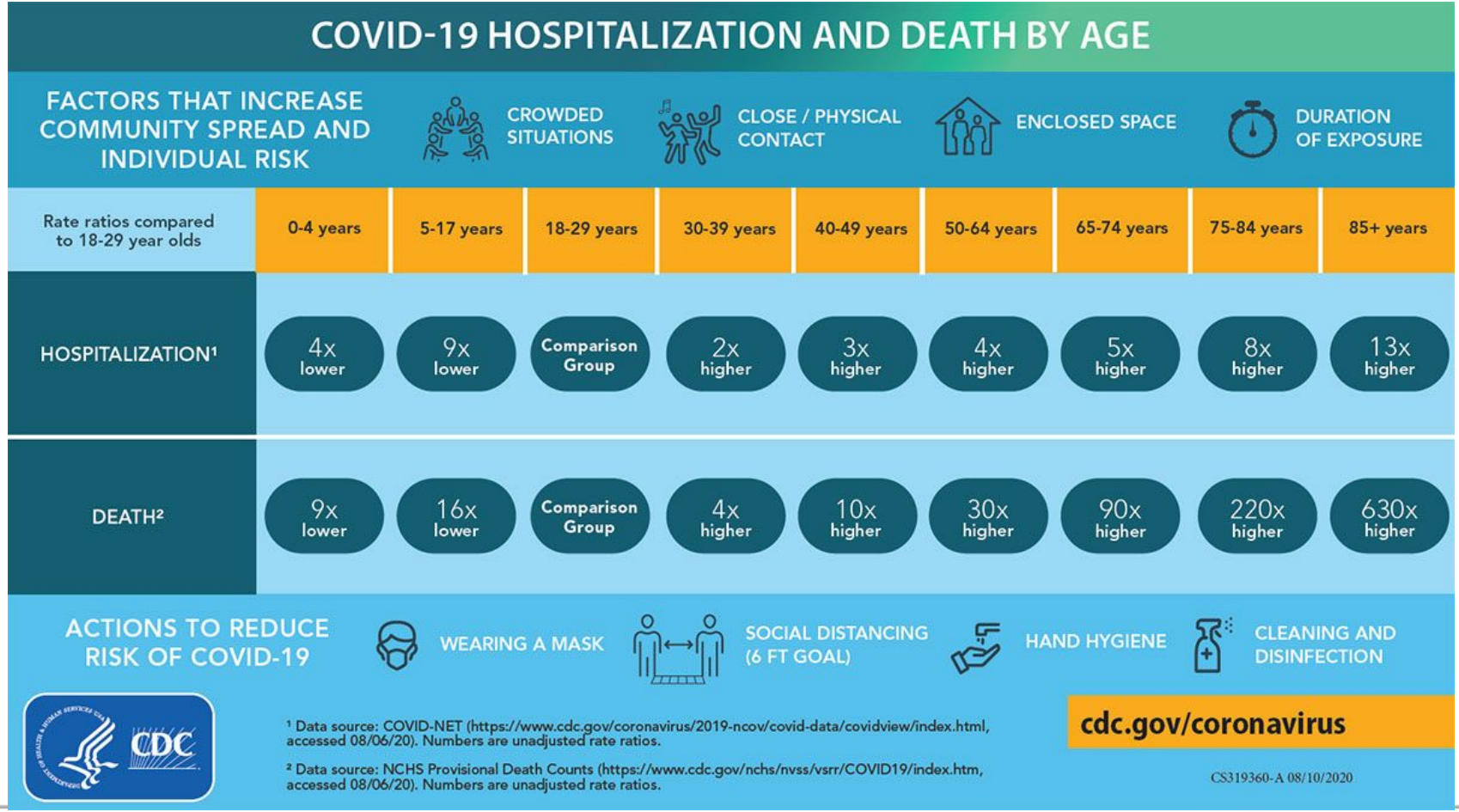

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Myth 4: “I don’t need to get a vaccine, I can rely on others getting it.”

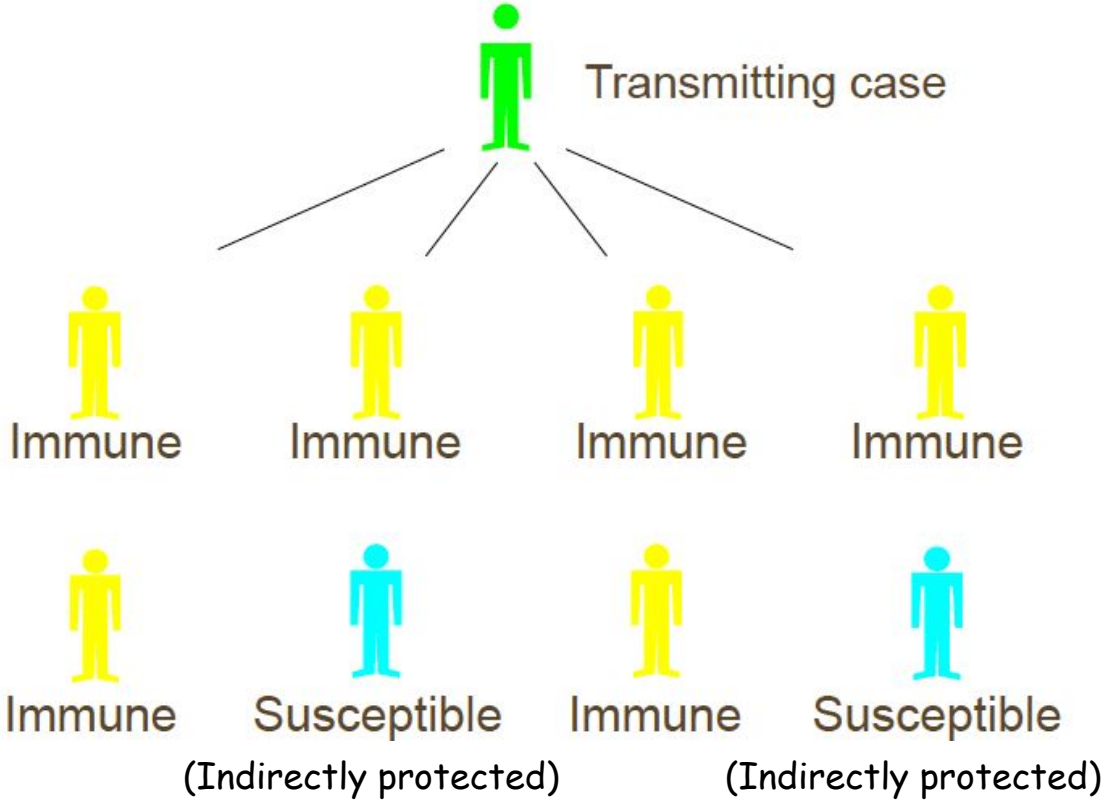
Herd Immunity

The most important factor for herd immunity is the R0

R0-The average # secondary infections from single infected source

Herd Immunity Threshold =

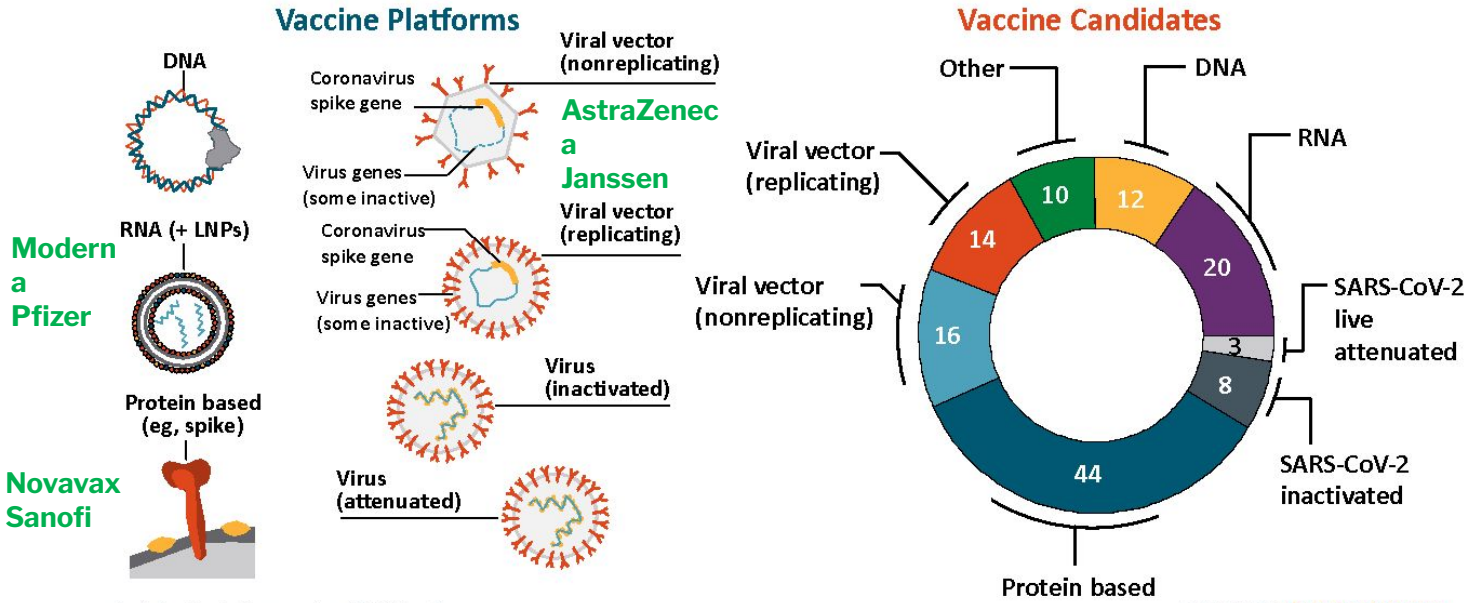
1-1/R0 (ex. R0 = 4, HIT is 75%)



Herd immunity hurdle is dependent on reproduction number

Infection	Basic Reproduction Number (R_0)	Crude Herd Immunity Threshold (%)
Diphtheria	6-7	85
Influenza	1.4-4	30-75
Measles	12-18	92-94
Mumps	4-7	75-86
Pertussis	12-17	92-94
Polio	2-15	50-93
Rubella	6-7	83-85
Smallpox	5-7	80-85
SARS-CoV-2	2-3	60-70%

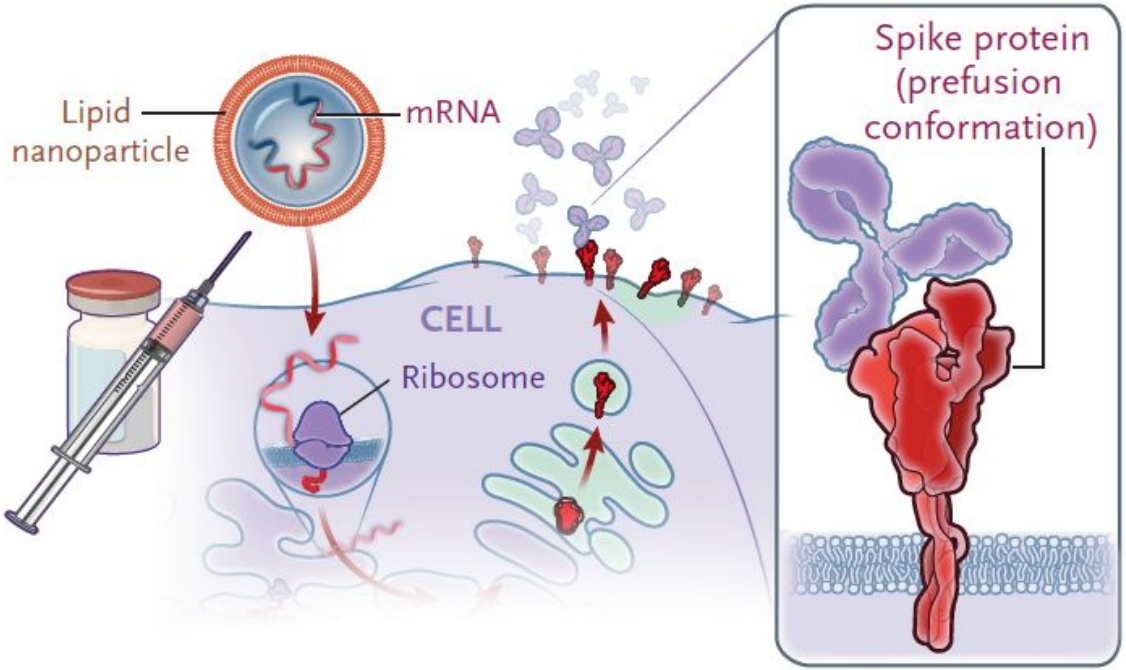
Vaccine Candidates in Development for SARS-Cov-2



Funk. Frontiers in Pharmacology. 2020;[Epub].

Slide credit: clinicaloptions.com

Design of mRNA COVID-19 Vaccine



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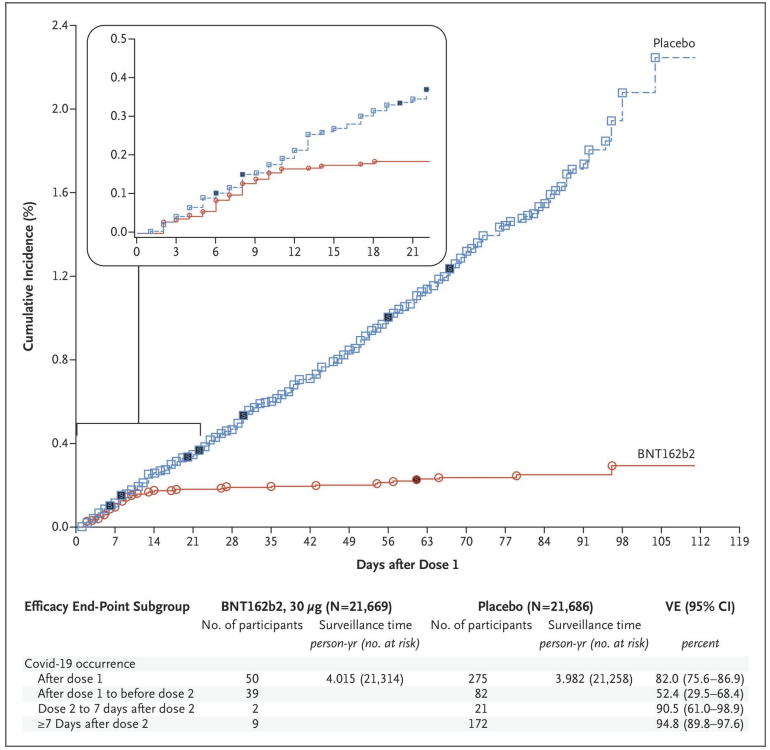
Efficacy of Pfizer mRNA vaccine



Efficacy End-Point Subgroup	BNT162b2, 30 μg (N=21,669)		Placebo (N=21,686)		VE (95% CI)
	No. of participants	Surveillance time *person-yr (no. at risk)*	No. of participants	Surveillance time *person-yr (no. at risk)*	*percent*
Covid-19 occurrence					
After dose 1	50	4.015 (21,314)	275	3.982 (21,258)	82.0 (75.6–86.9)
After dose 1 to before dose 2	39		82		52.4 (29.5–68.4)
Dose 2 to 7 days after dose 2	2		21		90.5 (61.0–98.9)
≥7 Days after dose 2	9		172		94.8 (89.8–97.6)

95% effective after two shots

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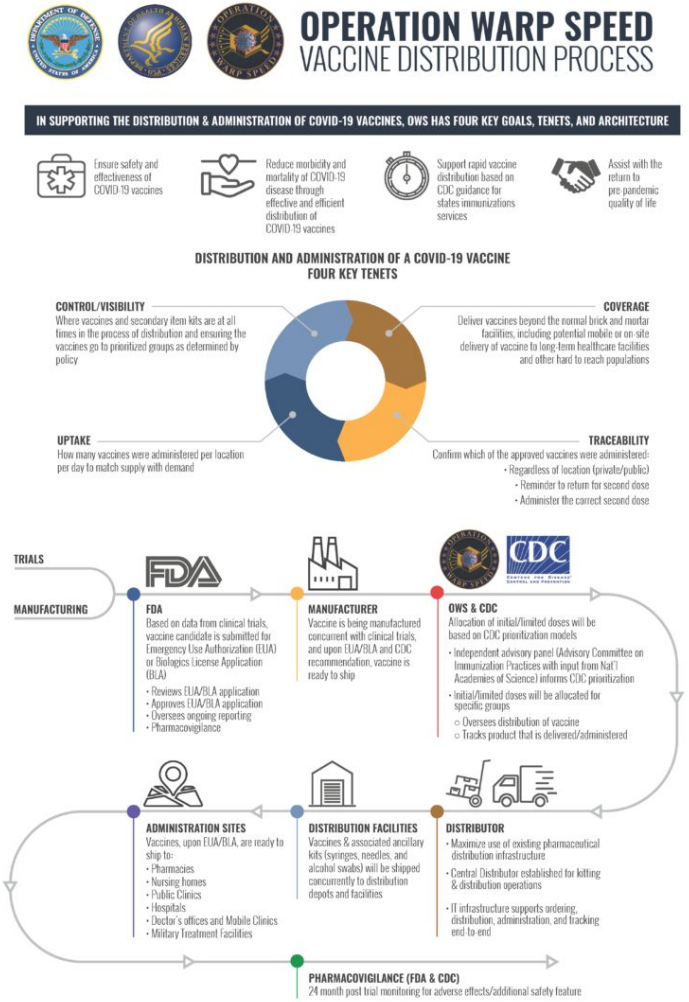
Myth 5: “If I get my vaccine, I don’t have to wear a mask anymore”

Vaccine Rollout

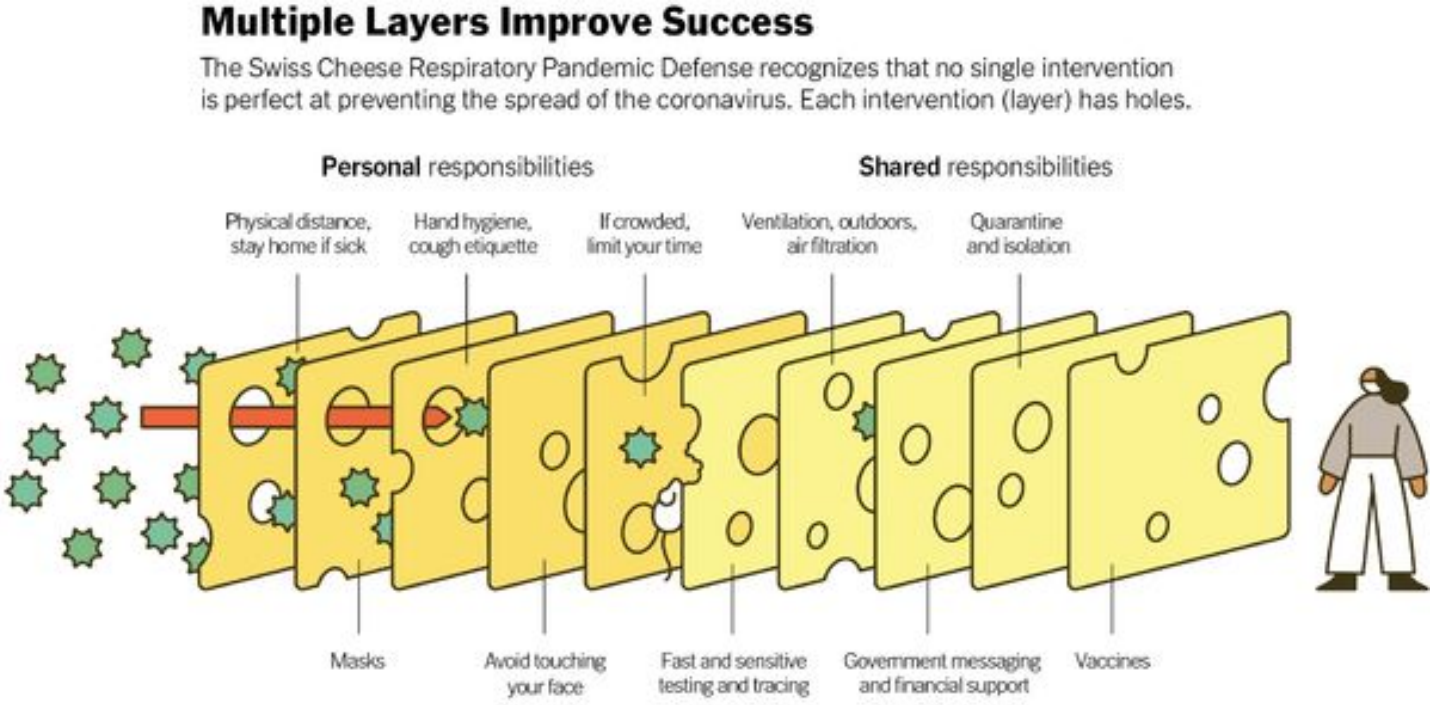
Vaccine effectiveness is based on patients receiving a safe vaccine, not on the development of a safe vaccine

Distribution is a key issue currently, which delays others in getting vaccinated

While the vaccine is 95% effective, it is not 100% and you can still spread COVID-19 to others, even though your symptoms may be mild.



Preventing COVID-19



Conclusions

- **SARS-CoV-2 continues to surge in parts of US with continued outbreaks**
- **While droplets are likely the largest mode of transmission, airborne spread through small particle aerosol transmission may occur in the right context**
- **Although case fatality rates are low, our high case numbers is the reason for the United States high rate of death/100,000**
- **A multi-faceted approach of masking, distancing, and vaccination is necessary for stopping the pandemic**

Questions?