

What Churches Need to Know About COVID-19

Frederick Southwick, M.D.

Professor of Medicine

Infectious Diseases

What can happen when
someone becomes infected with
SARS-CoV-2?

Ms M. is a middle-aged woman who serves as a respiratory therapist at medical facility (not UF Health)

6 days before hospitalization she was exposed to a 3 COVID-19 positive patients while changing tracheostomy tubes (produces aerosols). Only wearing a surgical mask

3 days later she was turned away from Diabetes clinic because of a fever.

4 days after exposure – **fever, fatigue, chills, and a dry hacking cough**

5 days – walked to the kitchen, became very **short of breath O2 sat 83%**

6th day admitted – **102.6 F, and O2 sat 88%** CXR pneumonia, +PCR, 4L O2

Day 2 hospital – **RR 38 O2 sat 88%** 100% to MICU, intubated, 70% oxygen
pO2 = 74, **Required proning to improve oxygenation**

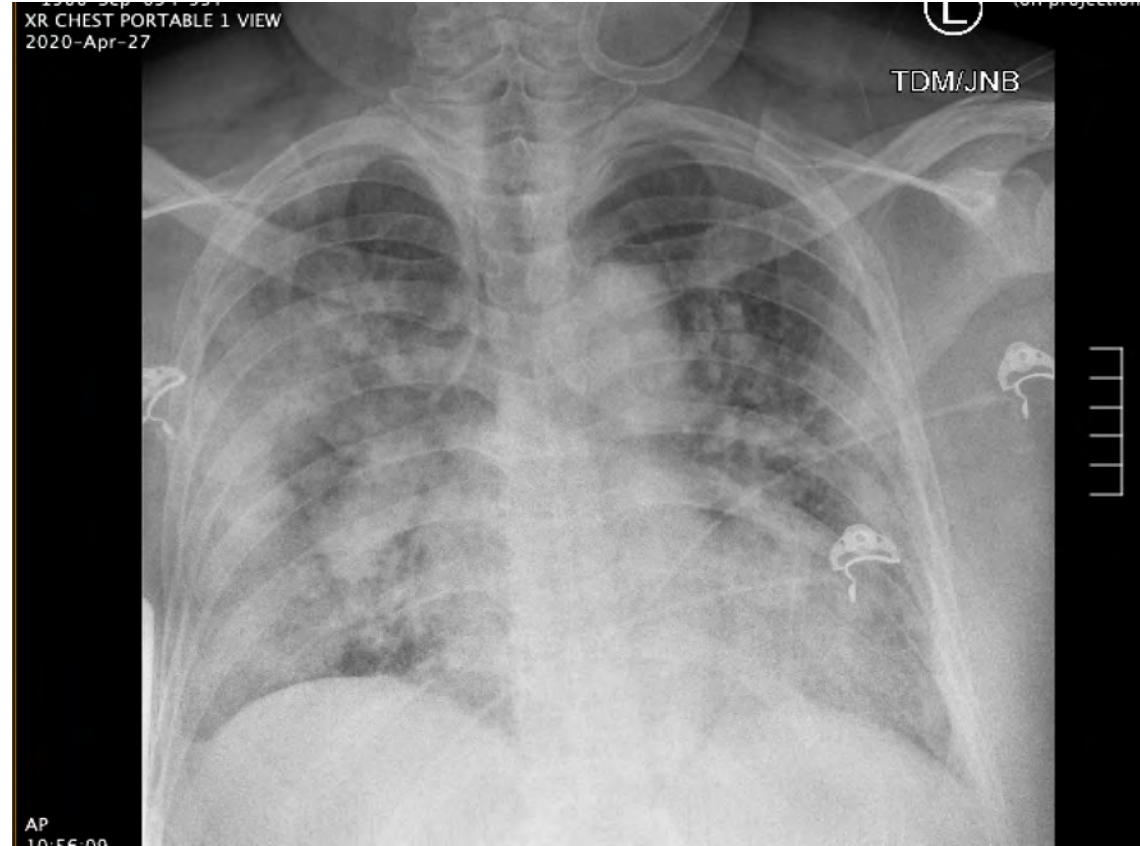
Day 3-16 – shock, kidney failure, Day 6 received IV convalescent plasma, 48 hours after improved.

Day 17 extubated, now undergoing rehabilitation for severe weakness

Day 1



Day 2



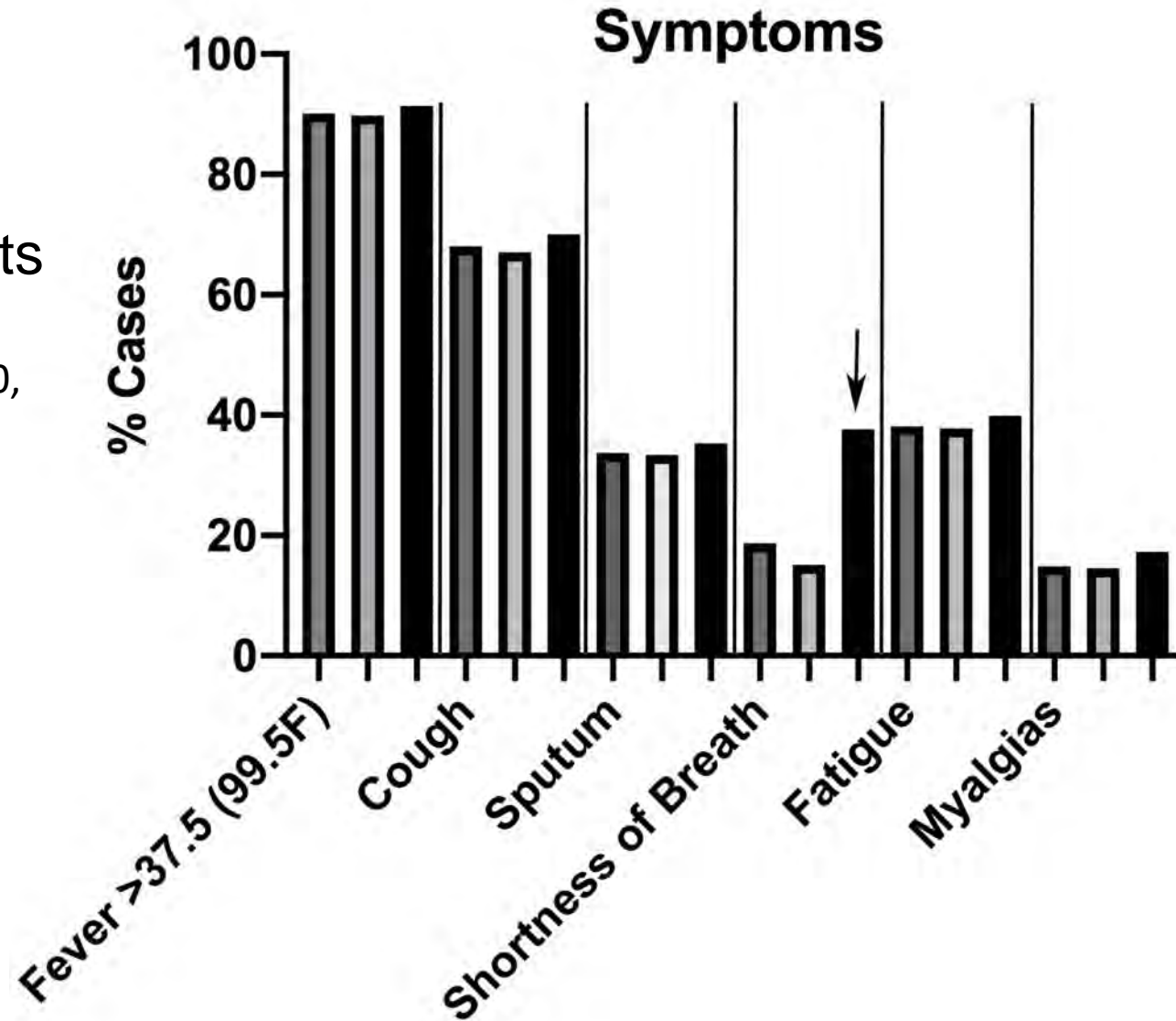
Consequences of her infection

- Acute Respiratory Distress Syndrome
- Shock (BP 70 systolic)
- Renal failure (no urine output)
- She nearly died
- This is not a rare experience. Ask any doctor or nurse in a large metropolitan hospital.

Know the symptoms of COVID-19

1099 patients

Guan NEJM 2020,



Additional symptoms

Headache

Nausea and Vomiting

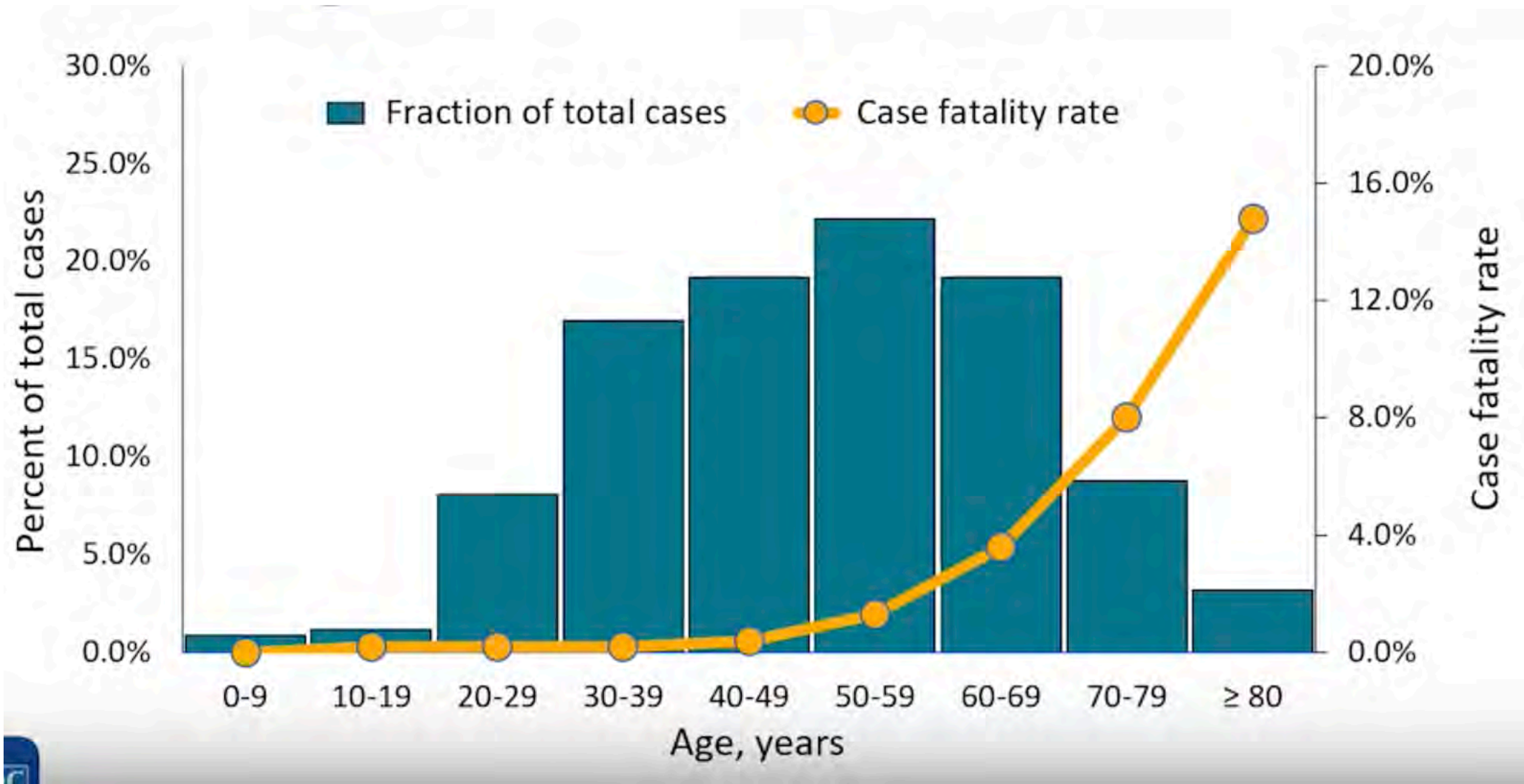
Diarrhea and Abdominal pain

Loss of smell and taste

Who is at higher risk?

	Case Fatality %
• Overall Mortality	0.5-3.5 (influenza 0.1) 5-35 X higher
• Diabetes	7.3
• Hypertension	6.0
• Cardiovascular disease	10.5
• Chronic lung disease	6.3
• Obesity	?
• Cancer	5.6

Mortality by age group (Chang Chinese CDC weekly report 2-11-20, image courtesy of Dr. John Brooks CDC USA)



Summary SARS-Cov-2 Clinical Manifestations and Outcome

- Fever, dry cough, shortness of breath, fatigue, myalgias, headache, diarrhea, **abdominal pain, loss of smell and taste**
- Hypoxia the main medical problem due to ARDS, shock & organ failure can also develop
- Case fatality rate = 0.5-3.5% which is 5-35 x higher than influenza
- Diabetes, HTN, CVD, COPD, Cancer, and Obesity higher mortality
- Age a key risk factor: over age 80 15-25% mortality

What's Causing This Deadly
Disease?

Seven Human Coronaviruses (HCoVs)

Common Coronaviruses (low pathogenicity, viral URIs)

- HCoV-229E
- HCoV-NL63
- HCoV-OC43
- HCoV-HKU1

Other Coronaviruses (higher pathogenicity)

- SARS-CoV - 2004
- MERS-CoV - 2013
- SARS-CoV-2 -2019

Disease caused by SARS-Cov-2 = COVID-19

(A neutral name without geography to reduce racism & blame)

The Virus

- SARS-CoV-2 is 96.2% identical at the whole-genome level to a bat coronavirus isolate RaTG13
- Related to SARS-CoV 2004
- Bat coronaviruses mutate and chance mutations adapted to humans
- Intermediate mammalian host Pangolin sold at live Chinese markets



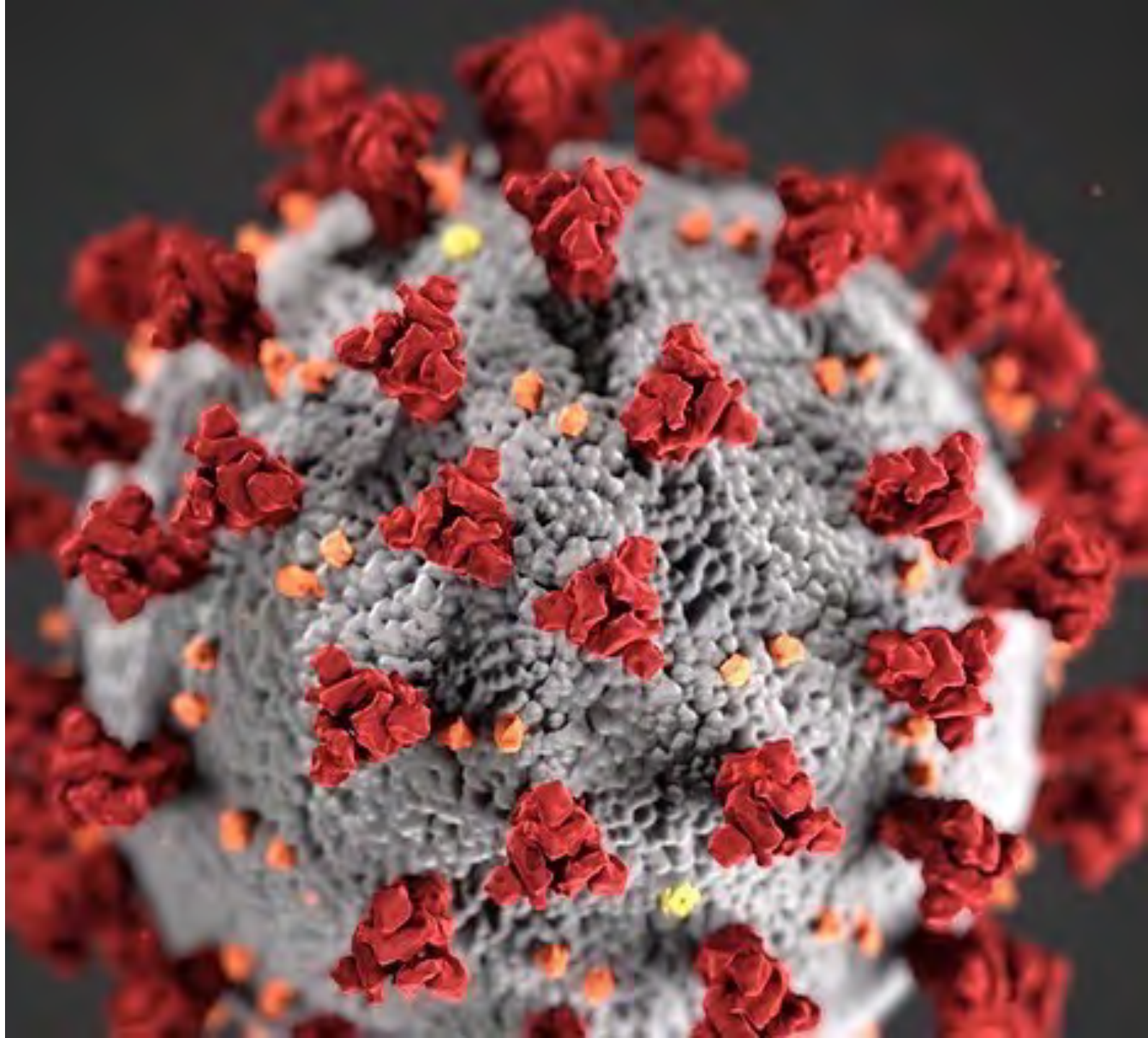
Virus Structure

S or surface protein
forms Knobs

Tolerates marked
mutations

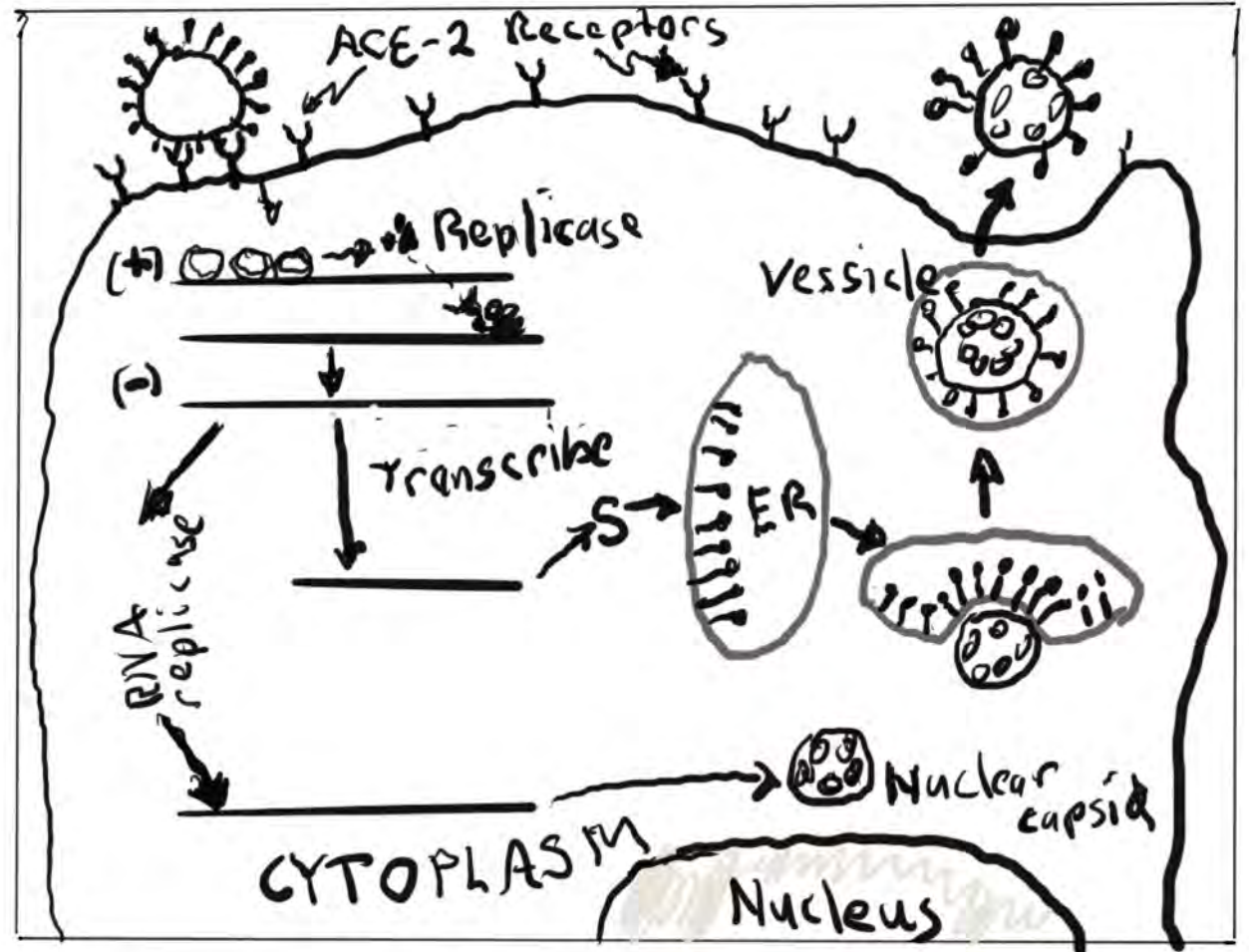
Bind to ACE-2 receptors
on bronchial epithelial
cells

Bind with high affinity to
human cells.



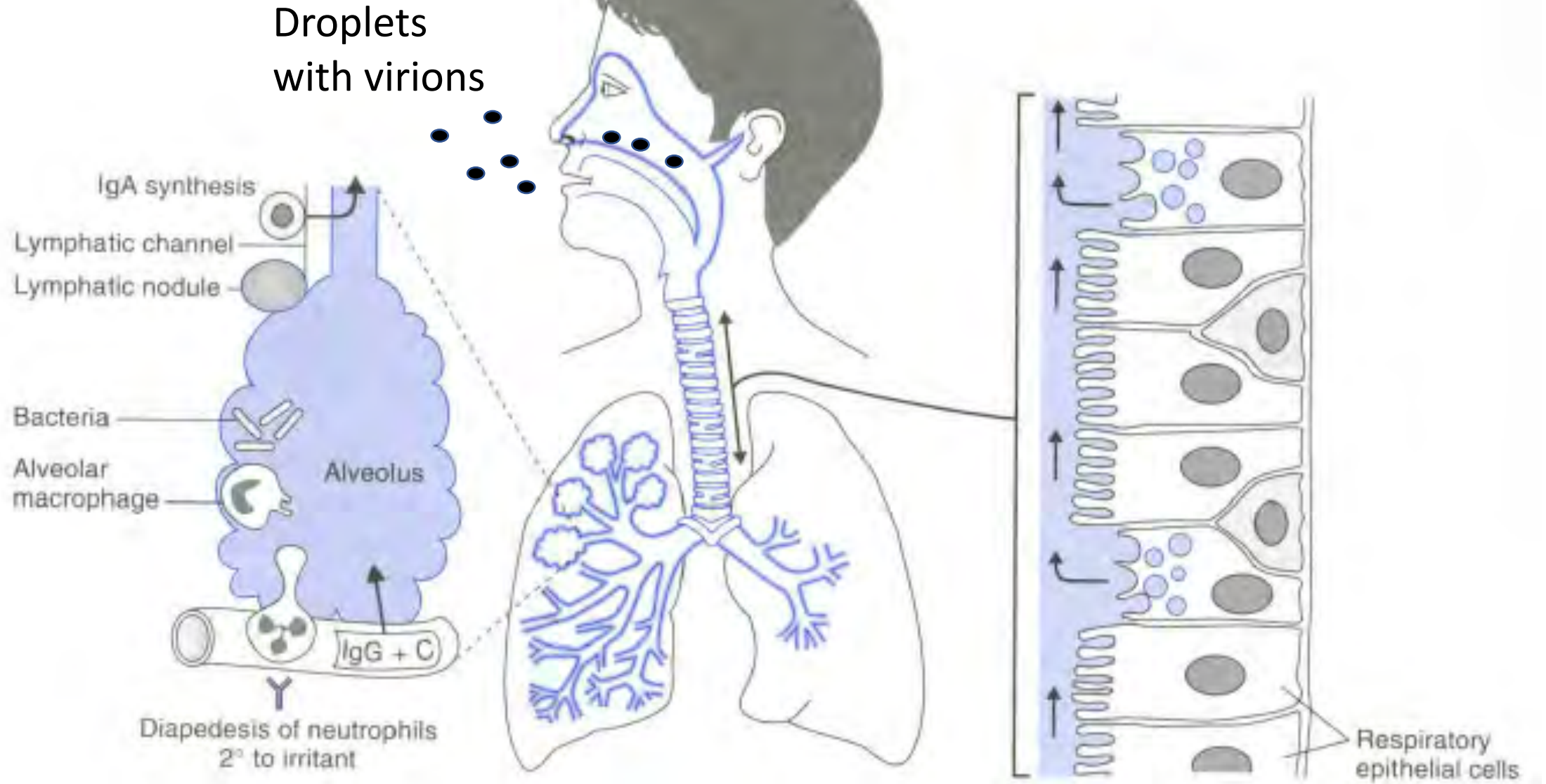
Intracellular virion replicates in the cytoplasm

- Binds human ACE-2 Receptors
- Endocytosed
- RNA replicated using replicase
- Proteins transcribed and assembled in Endoplasmic reticulum
- Nuclear capsid with RNA assembled in cytoplasm
- Viral assembly and vesicle formation
- Exocytosis and release.



Pre-symptomatic

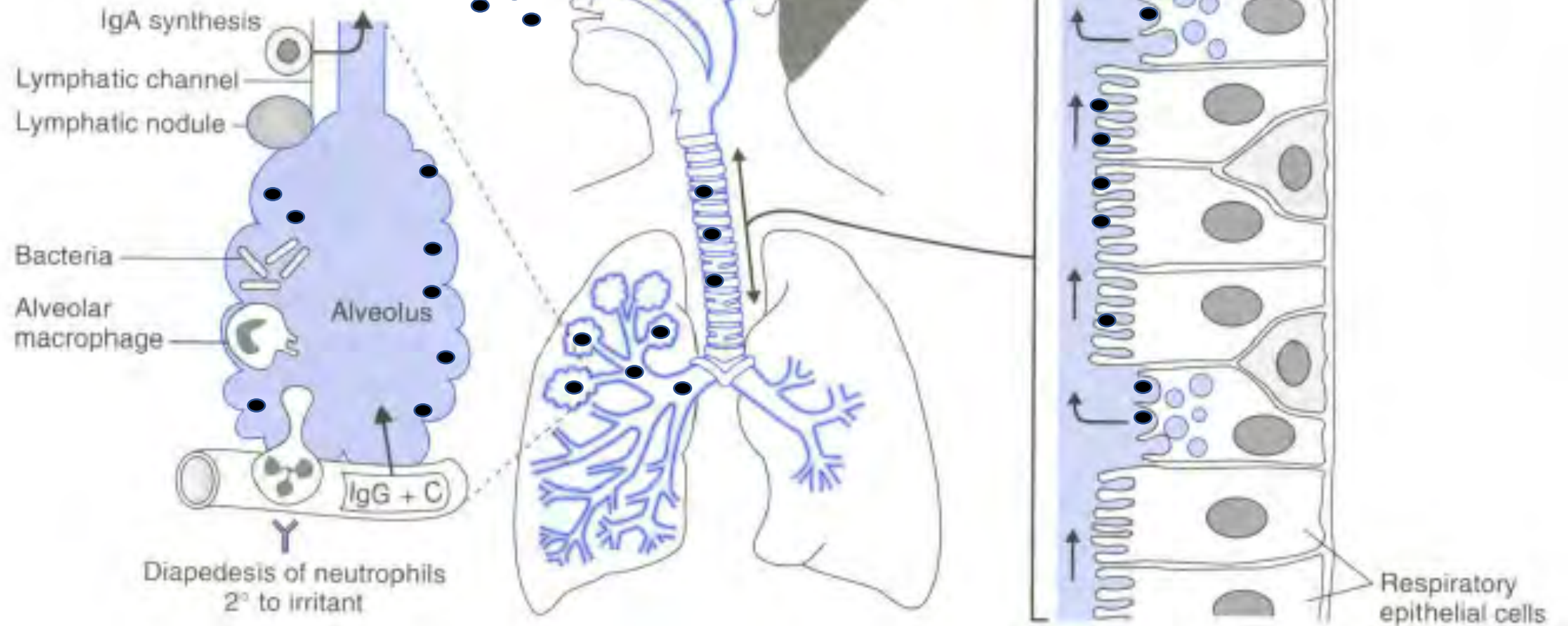
24-48 h



Symptomatic

> 48 h

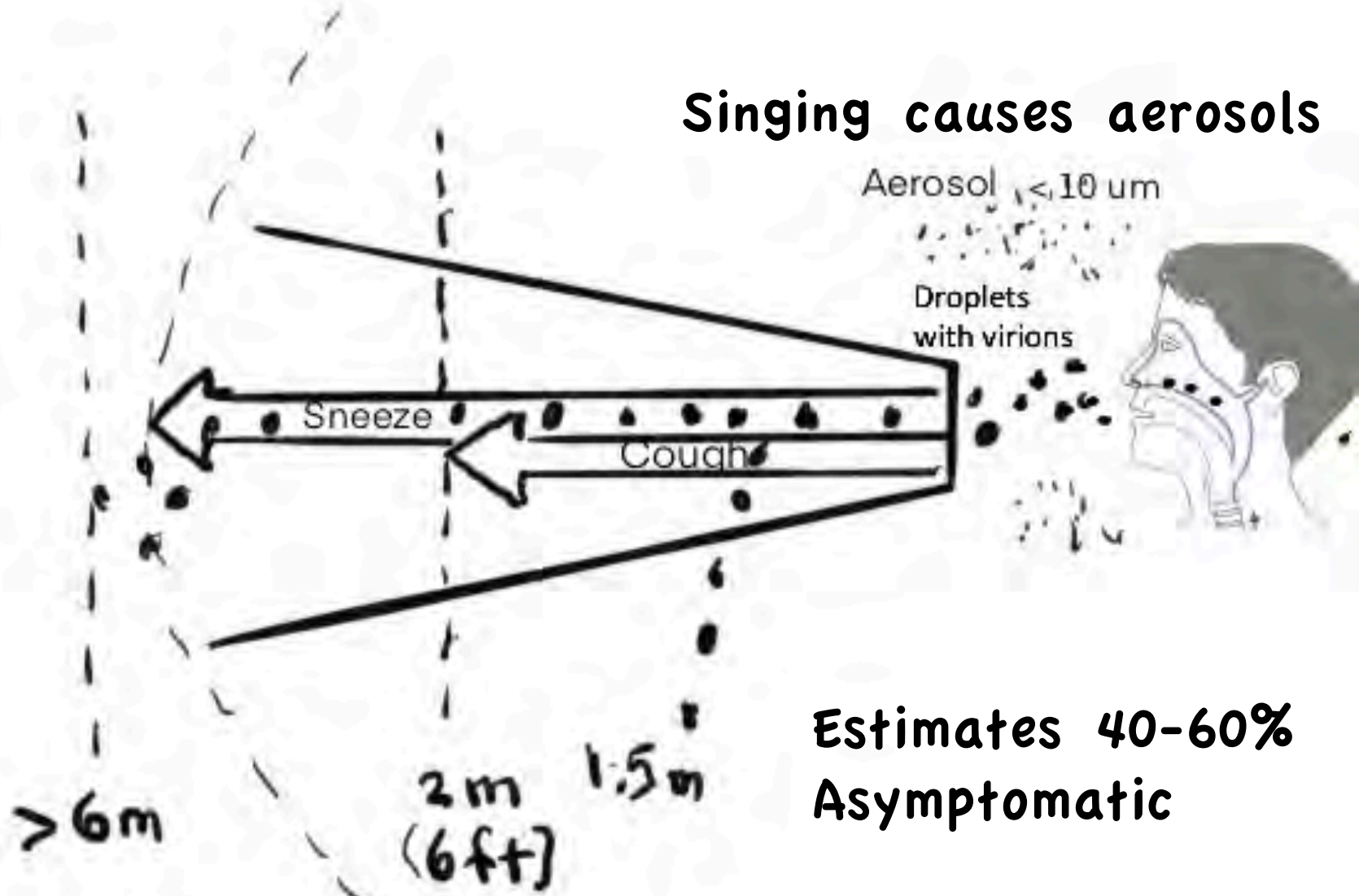
Droplets
with virions



How does the virus spread?

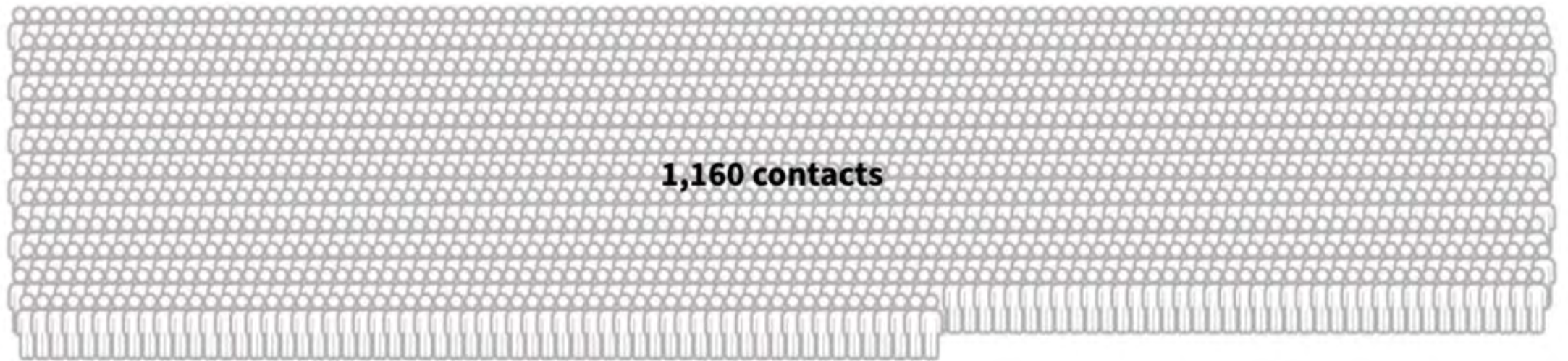
Transmission

- Primarily Respiratory Secretions
 - **Droplets** associated with coughing or land on surfaces (survival for hours to days, up to 3 days on stainless steel, plastic).
- Stool – found in stool but difficult to culture, but no cases observed
- Perinatal – not observed



Superspreaders: Case 31 South Korea -1,160 people

Case 31



1,160 contacts

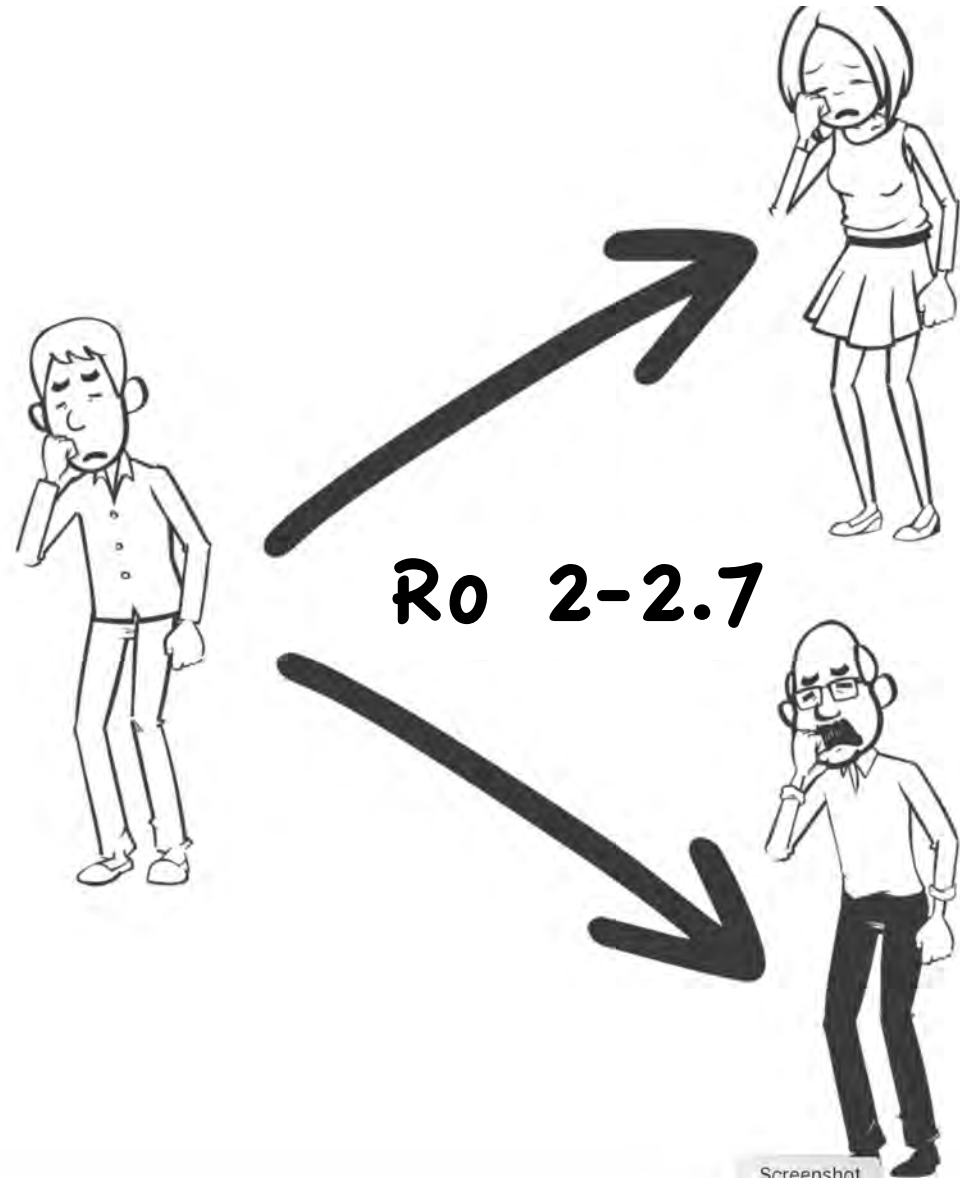
from REUTERS GRAPHICS

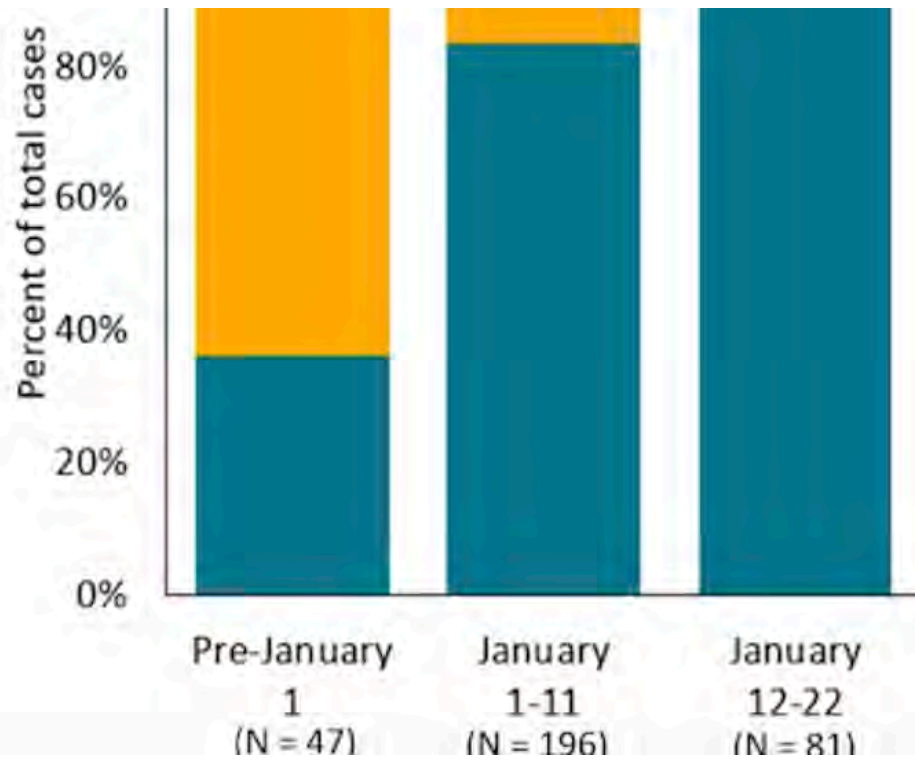
This patient had by far the most contacts initially traced
by the Korean Center for Disease Control

Large gatherings can be very dangerous

Transmission

- Infected host can infect 2.0-2.7 others (R_0) highly infectious
- 10% of close contacts develop the disease
- 80-85% contracted within the family (family clusters)



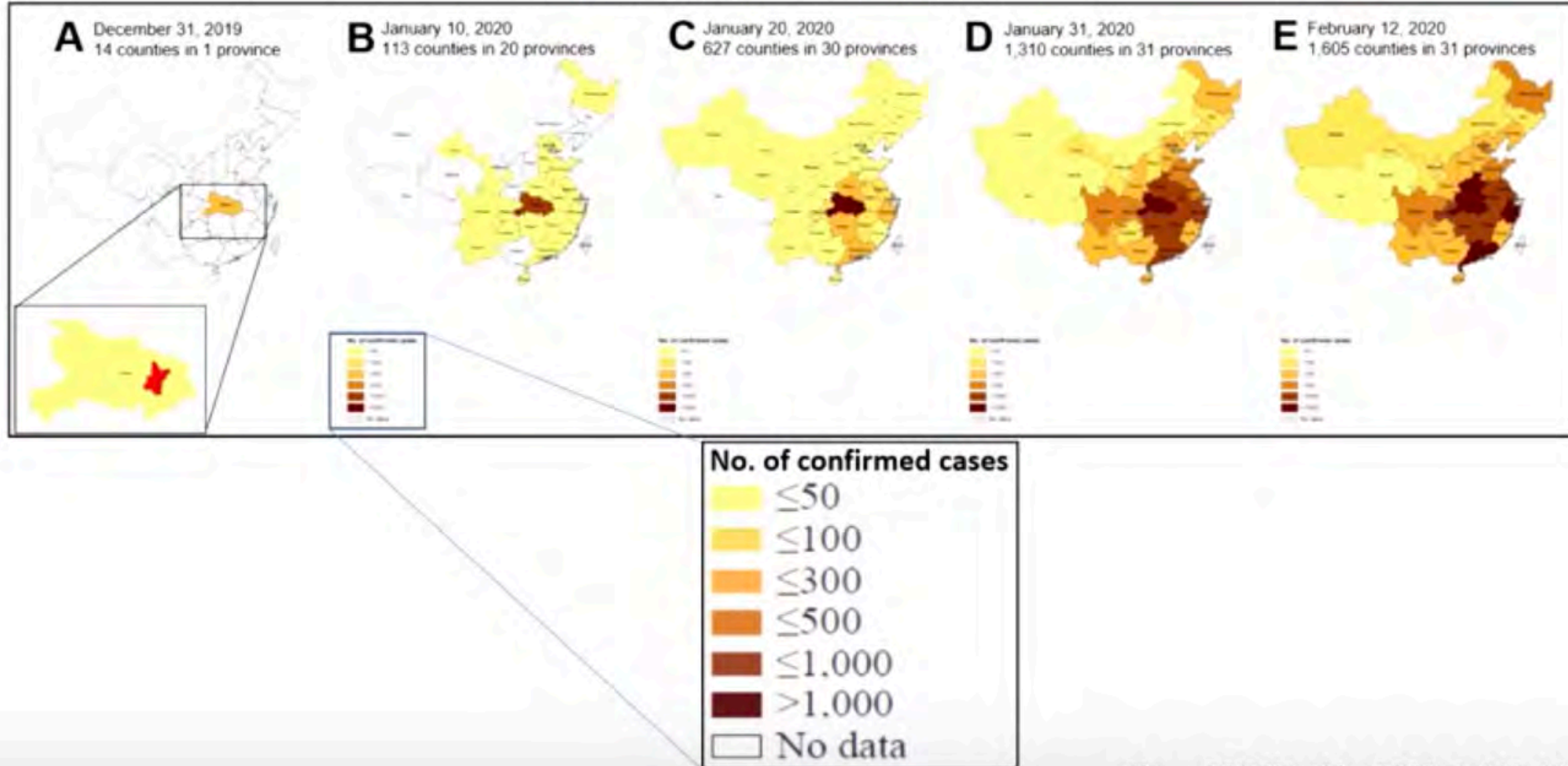


<https://www.healthpolicy-watch.org/>

Initial Point Source Outbreak (Huanan Market)

- Early cases from the market
- Within 10 days the majority were person to person spread outside of the market.

By symptom onset date and reporting province





COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)

Total Confirmed

7,076,187

Confirmed Cases by
Country/Region/Sovereignty

1,954,236	US
691,758	Brazil
476,043	Russia
288,827	United Kingdom
265,869	India
241,717	Spain
235,278	Italy
196,515	Peru
191,313	France
186,109	Germany
173,832	Iran
171,121	Turkey
134,150	Chile
117,103	Mexico



Cumulative Confirmed Cases

Active Cases

Incidence Rate

Case-Fatality Ratio

Testing Rate

Hospitalization Rate

Global Deaths

404,304

110,865 deaths
US

40,680 deaths
United Kingdom

36,455 deaths
Brazil

33,964 deaths
Italy

29,212 deaths
France

27,136 deaths
Spain

13,699 deaths

Global Deaths

8M

6M

4M

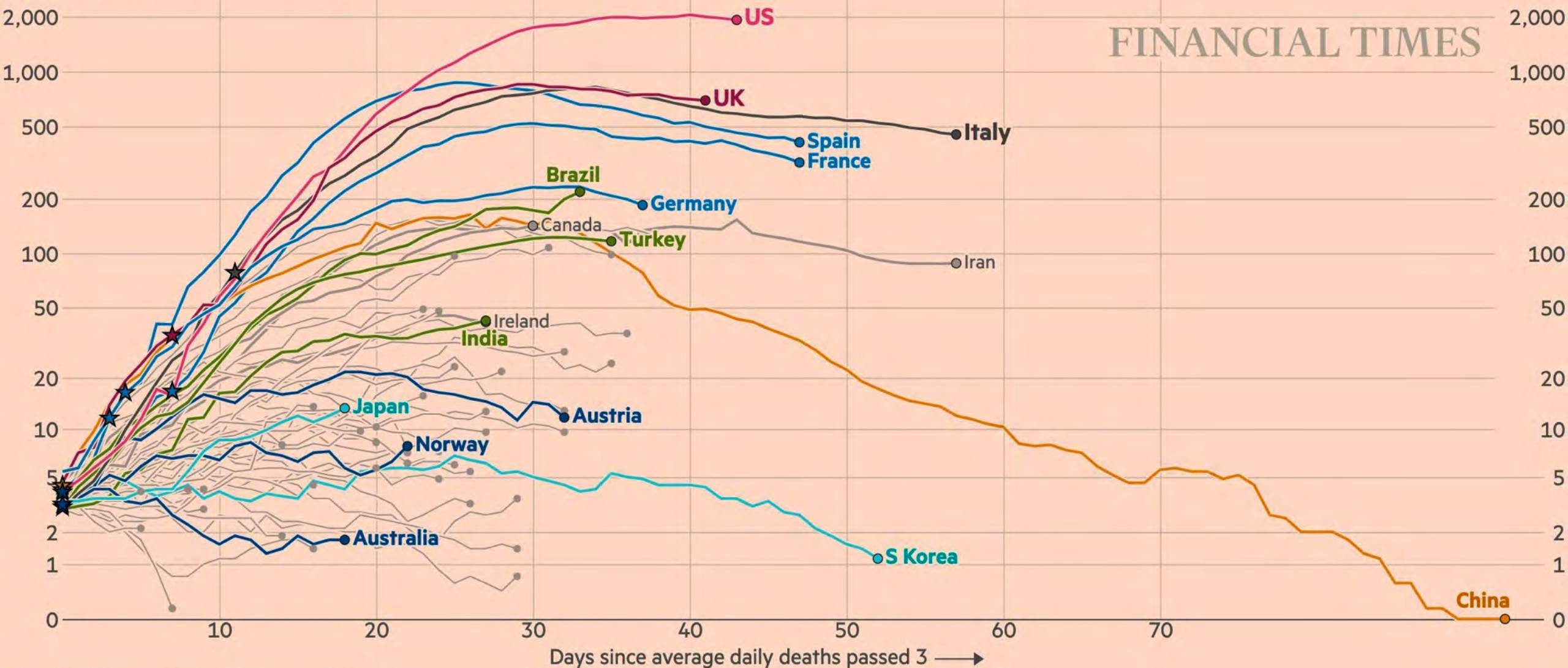
2M



Daily death tolls are now at their peak or falling in many western countries

Daily deaths with coronavirus (7-day rolling average), by number of days since 3 daily deaths first recorded

Stars represent national lockdowns ★



FINANCIAL TIMES

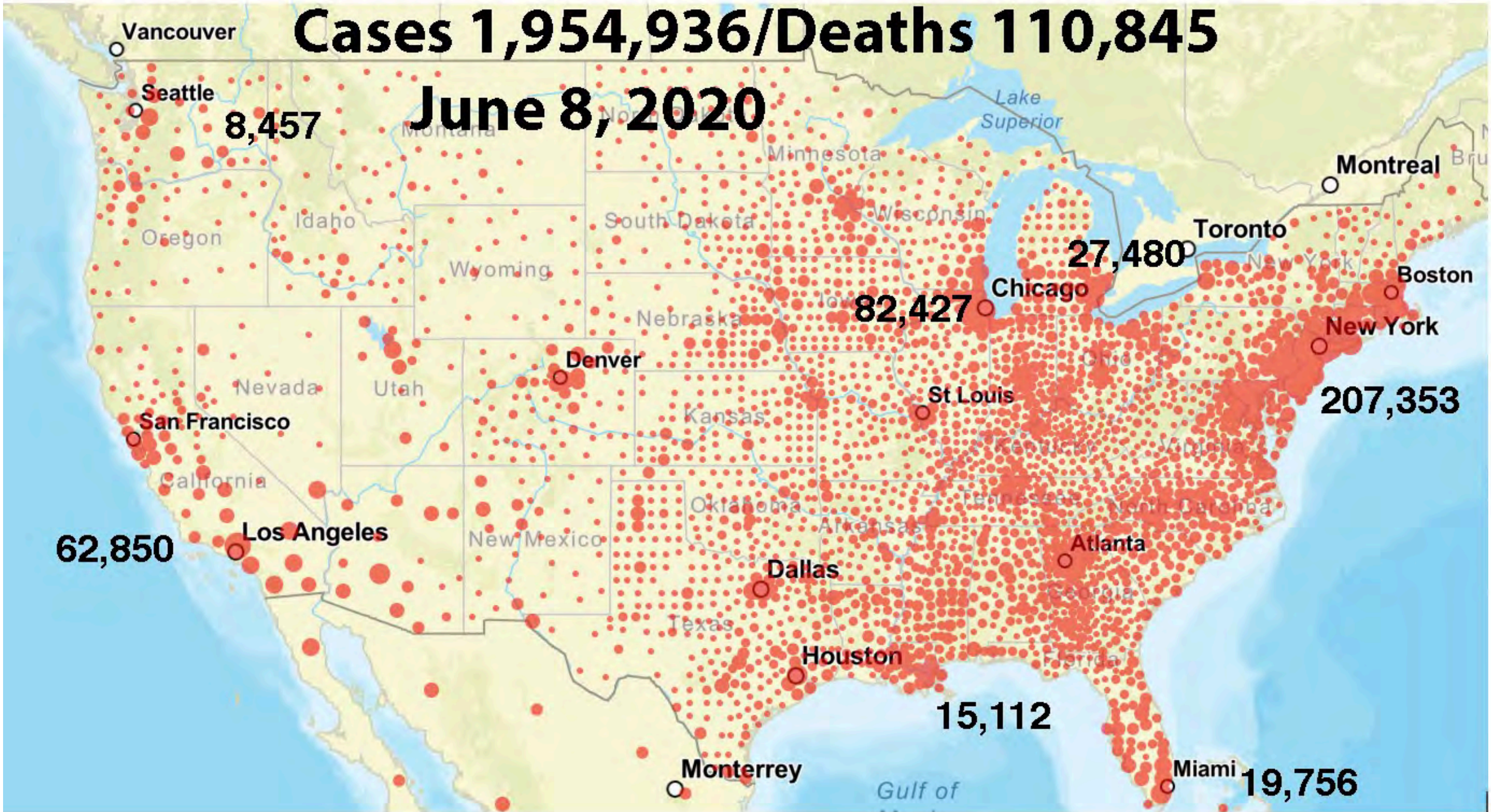
FT graphic: John Burn-Murdoch / @jburnmurdoch

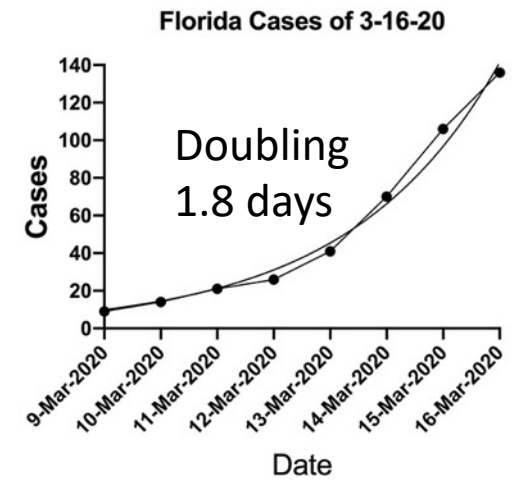
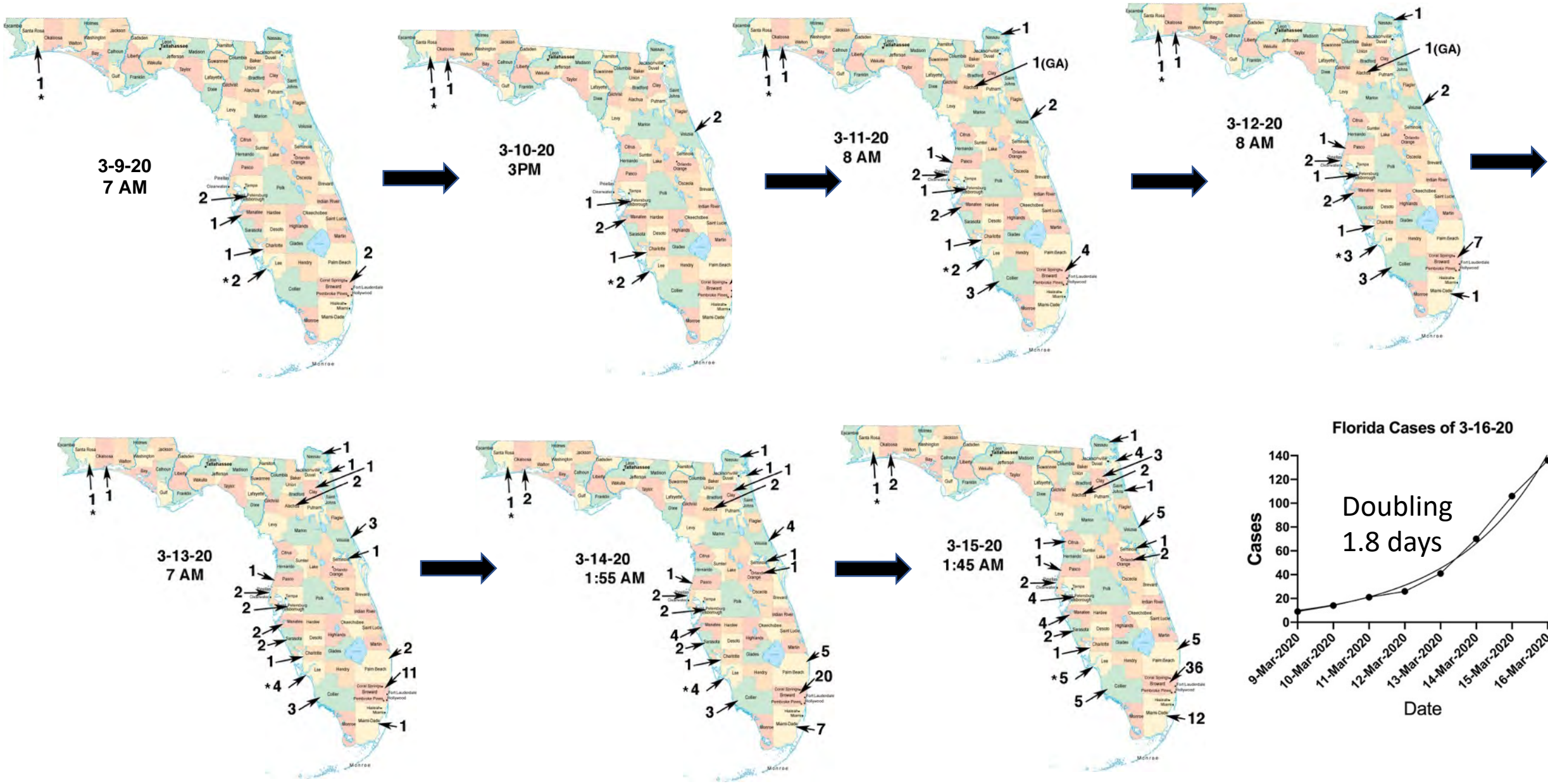
Source: FT analysis of European Centre for Disease Prevention and Control; FT research. Data updated April 25, 20:16 BST

© FT

Cases 1,954,936/Deaths 110,845

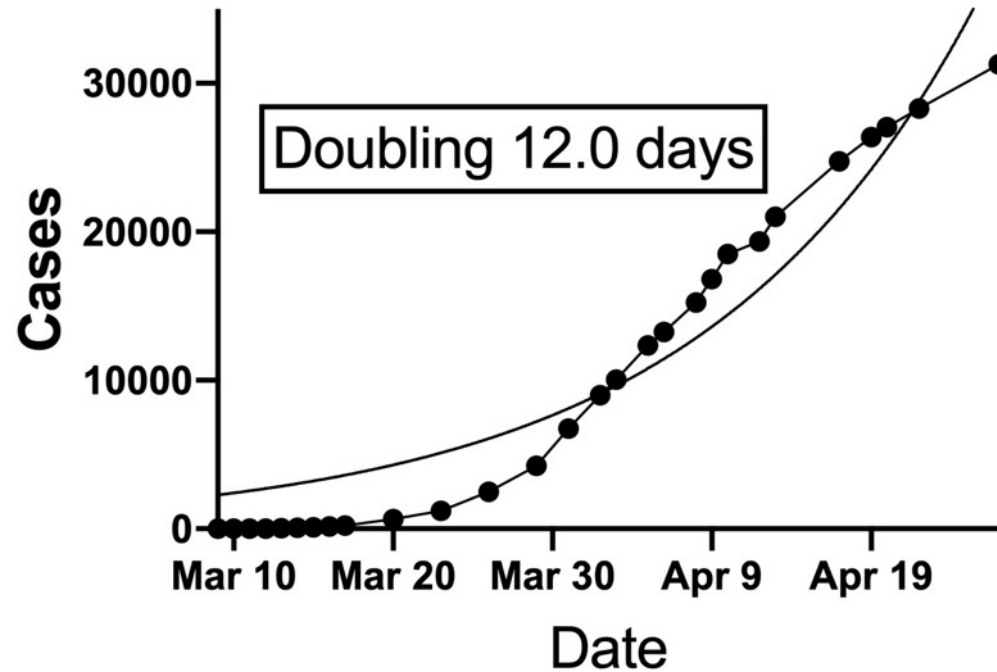
June 8, 2020



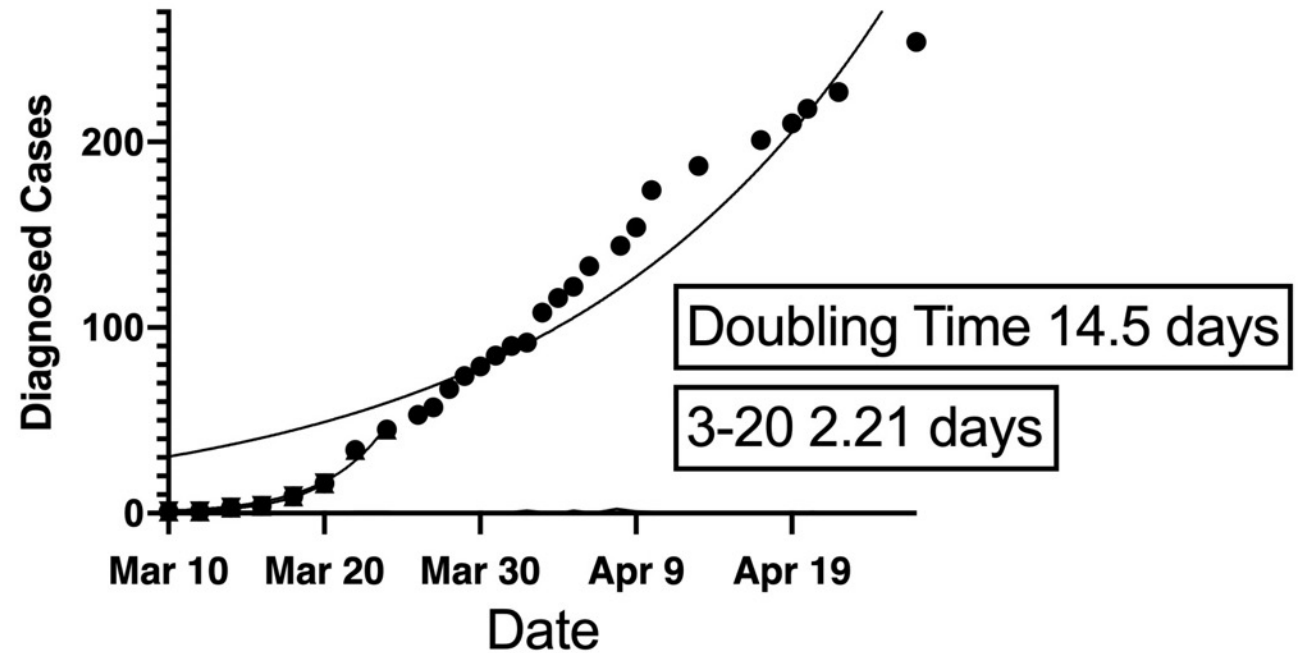


Doubling time slowed in Florida & Alachua County

Florida Cases of 4-27-20



Alachua County 4-27



Summary SARS-Cov-2 Epidemiology

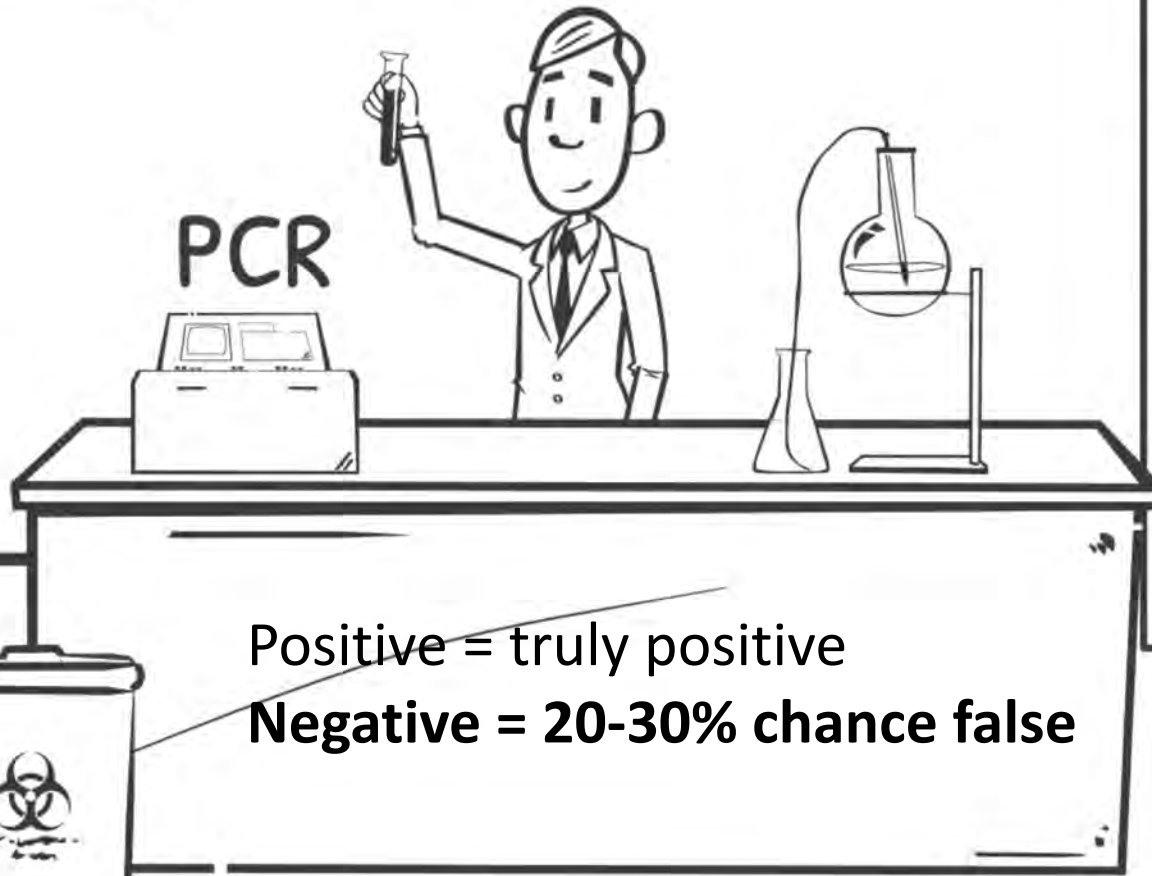
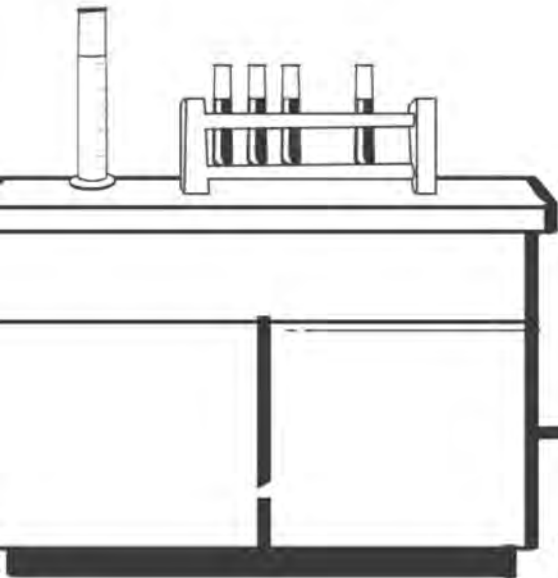
- Transmission by droplets and fomites (beware of superspreaders)
- Droplets can travel up to **6ft** (sneezes farther), **masks for everyone.**
- Began as a common source outbreak in a live animal fish market in Huanan, China
- Worldwide cases increased from 1.4 million on April 9th to 7 million
- Rapid intervention is the key to reducing cases (Pandora's Jar)
- U.S. Leads the world in cases (2 million) and in deaths (110,000)

SARS-CoV-2 Diagnosis and Prevention

Highly Specific

Highly Sensitive (10 virions)

Problem of sampling (70-80% sensitive)



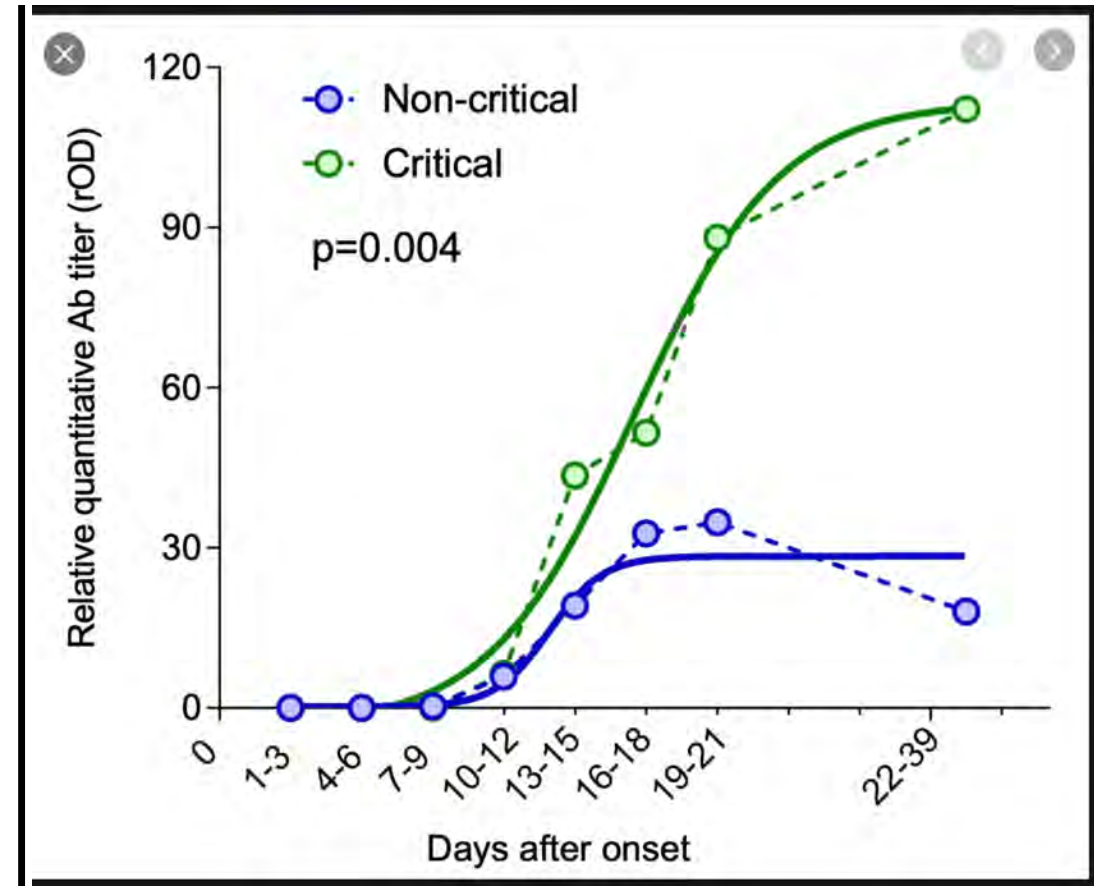
Positive = truly positive

Negative = 20-30% chance false



Role of Antibody testing

- By 7-14 days into infection IgG and IgM antibodies begin to be produced
- Peak antibody production by 28 days
- IgG antibody may persist for years
- A marker for past infection
- Helpful for assessing activity in specific locations
- Assessment of herd immunity
- Probably protective
- Problem of many inaccurate testing kits.



From Assay Genie



@Flickr Zldylmg

COVID-19 VACCINE

- Identify the ideal antigen target
? S Protein
- What is the best adjuvant?
- Human trials to prove efficacy

MINIMUM 18 months

1

Isolation -All infected individuals avoid contact with others and wear masks - distance maintained over 6 ft.

2

Quarantine- individuals in contact with the infected patient agree to avoid contact with others for 14 days

3

Social distancing of those > 70 yo

4

Social distancing of the entire population

5

Closing of schools and Universities



///
Suppression (1-5)

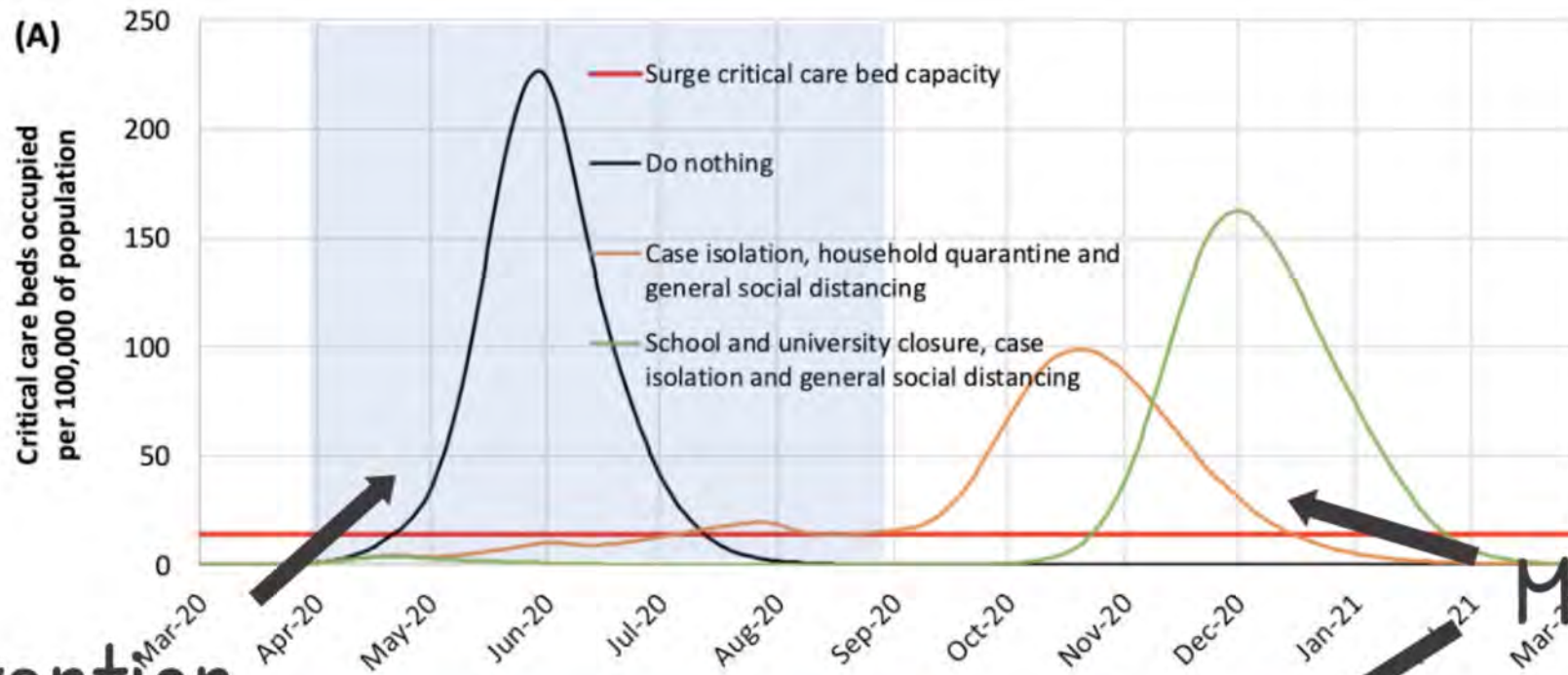
Reduce $R < 1$

Mitigation (1, 2, 4)

Reduce to slow $R > 1$

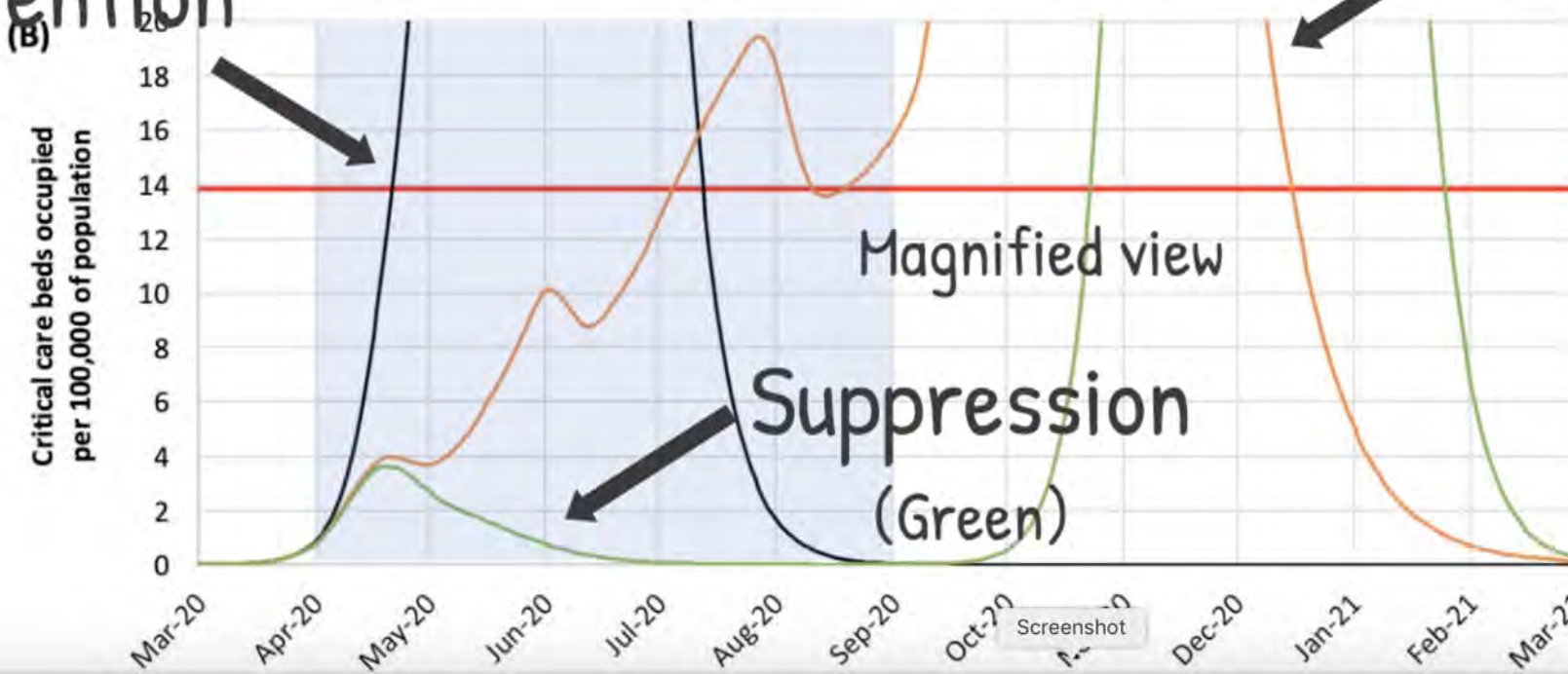
How do we stop
the spread?



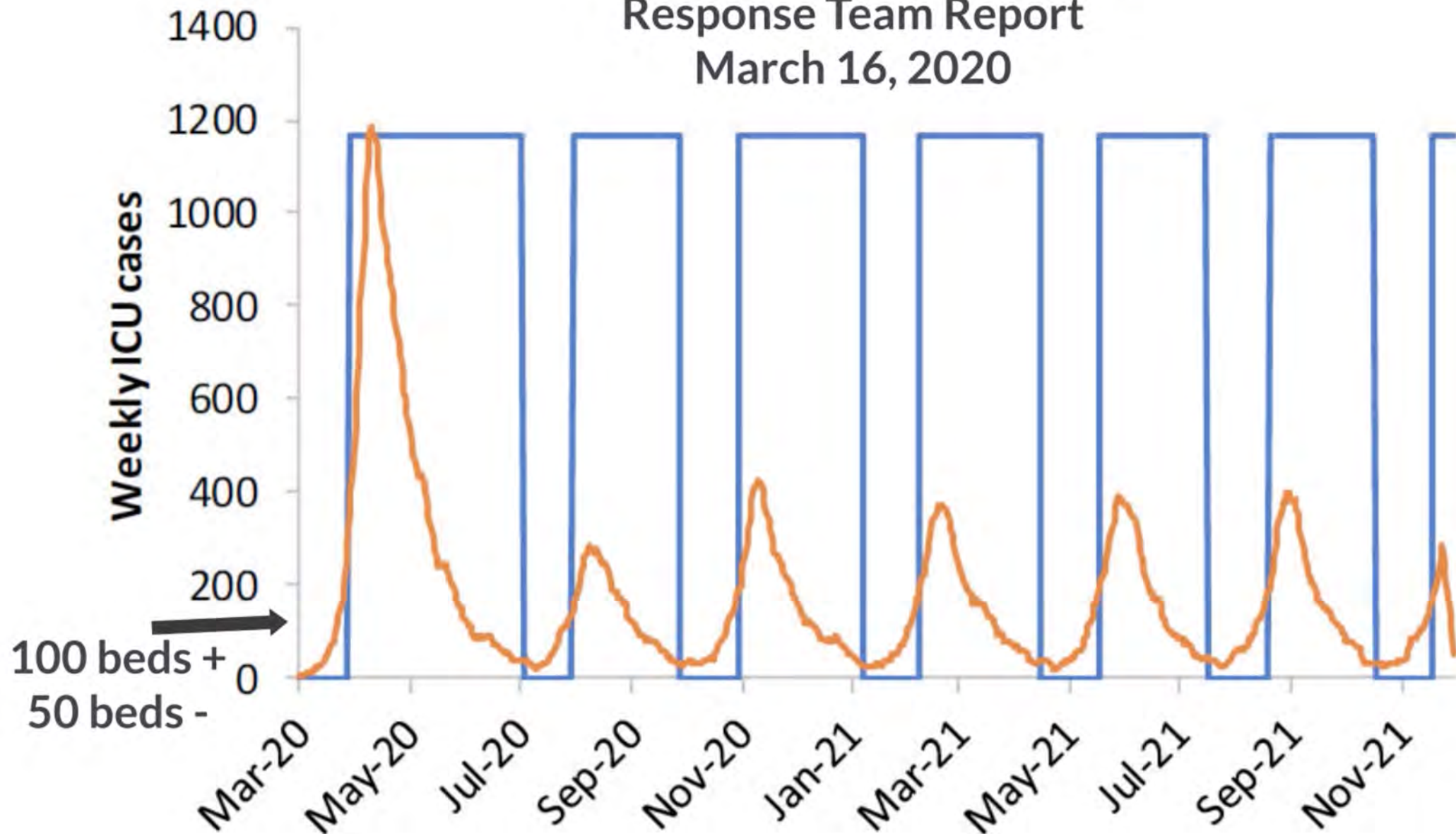


No intervention

Mitigation
(Orange)

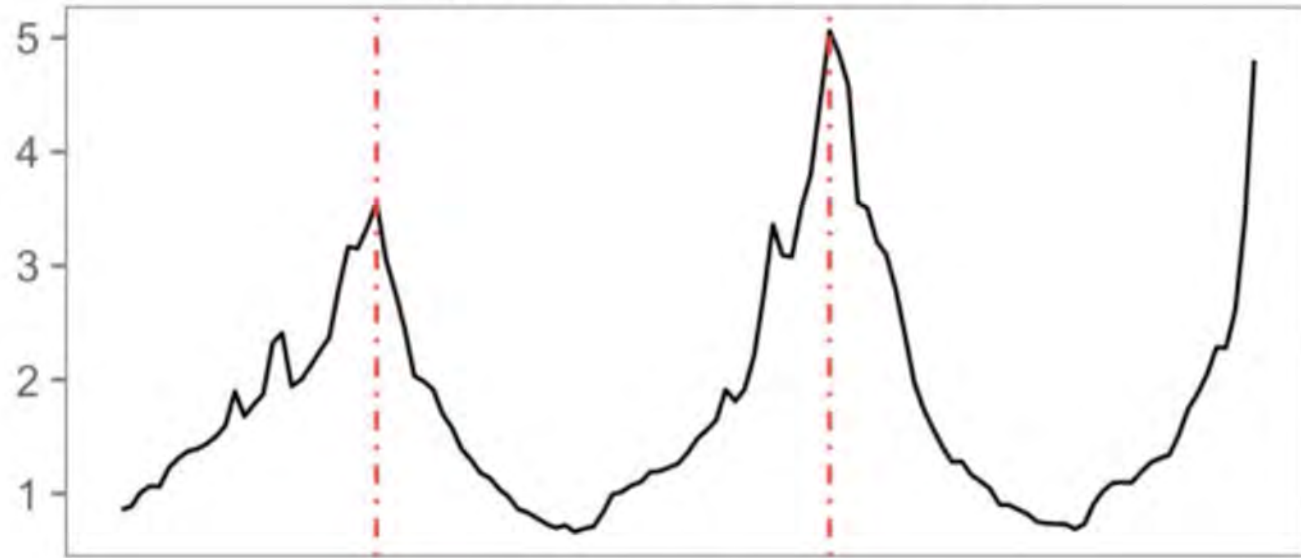


Imperial College COVID-19 Response Team Report March 16, 2020

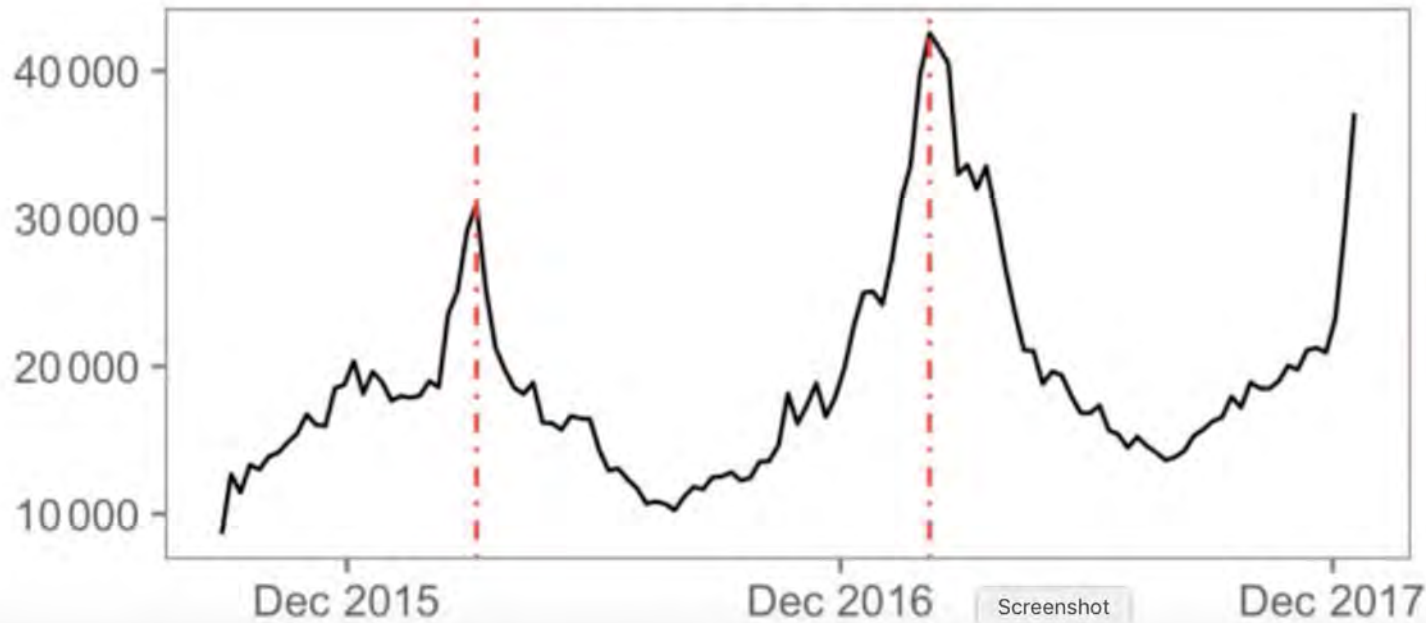


A. Miller
Clin Inf Dis
2018:67

ILI (% of Physician Visits for ILI)

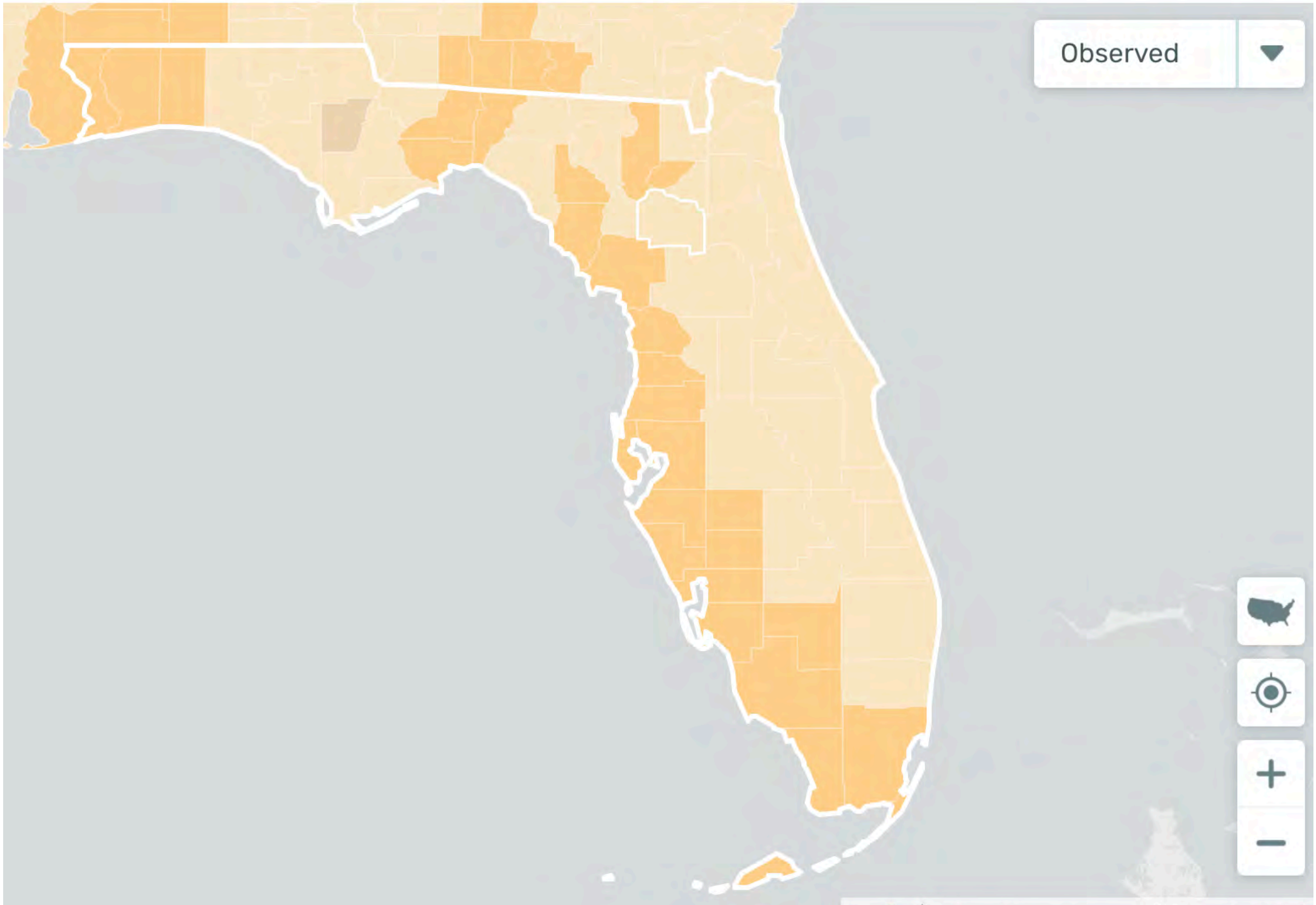


Total Fever Readings



Kinsa





Observed

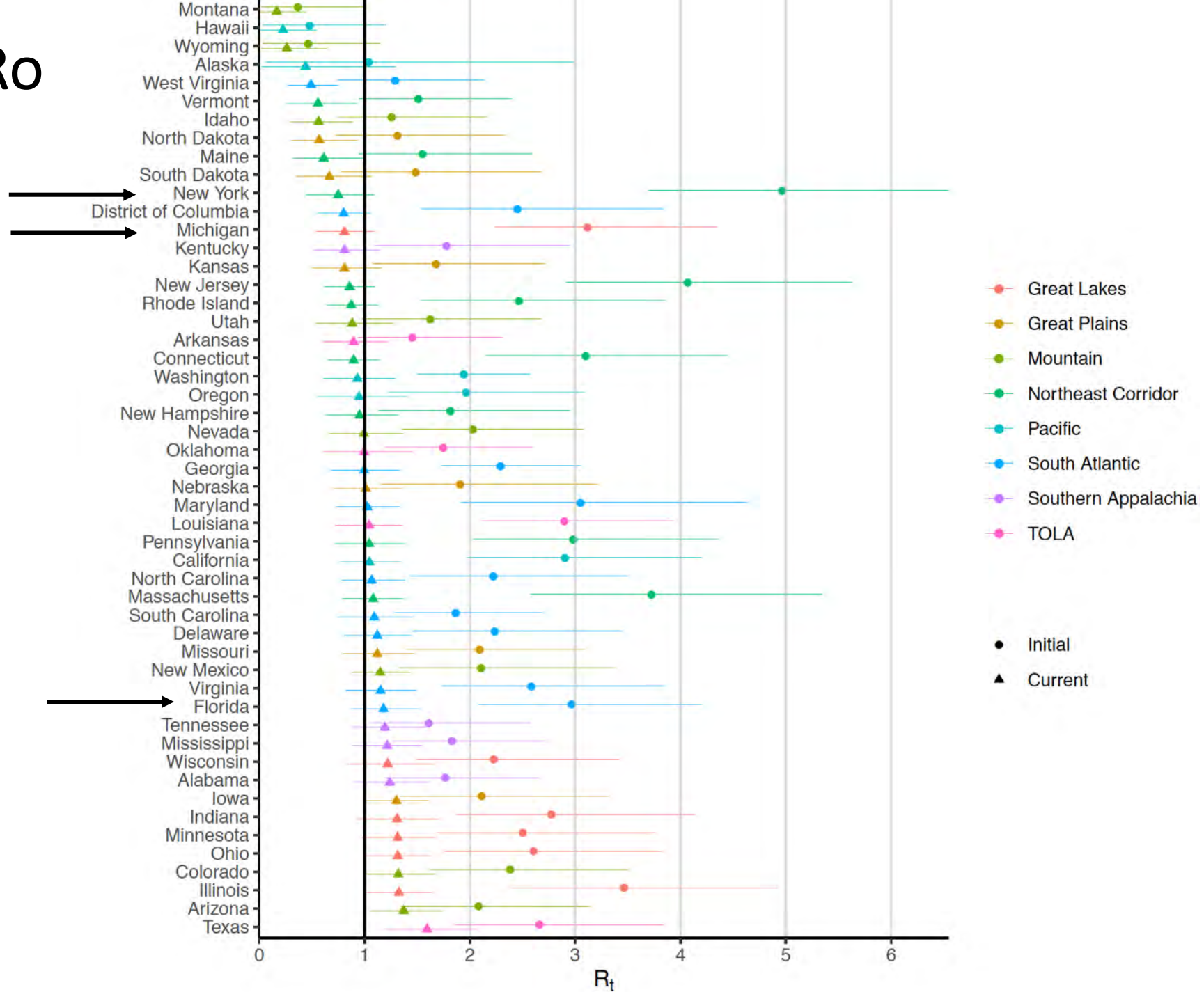


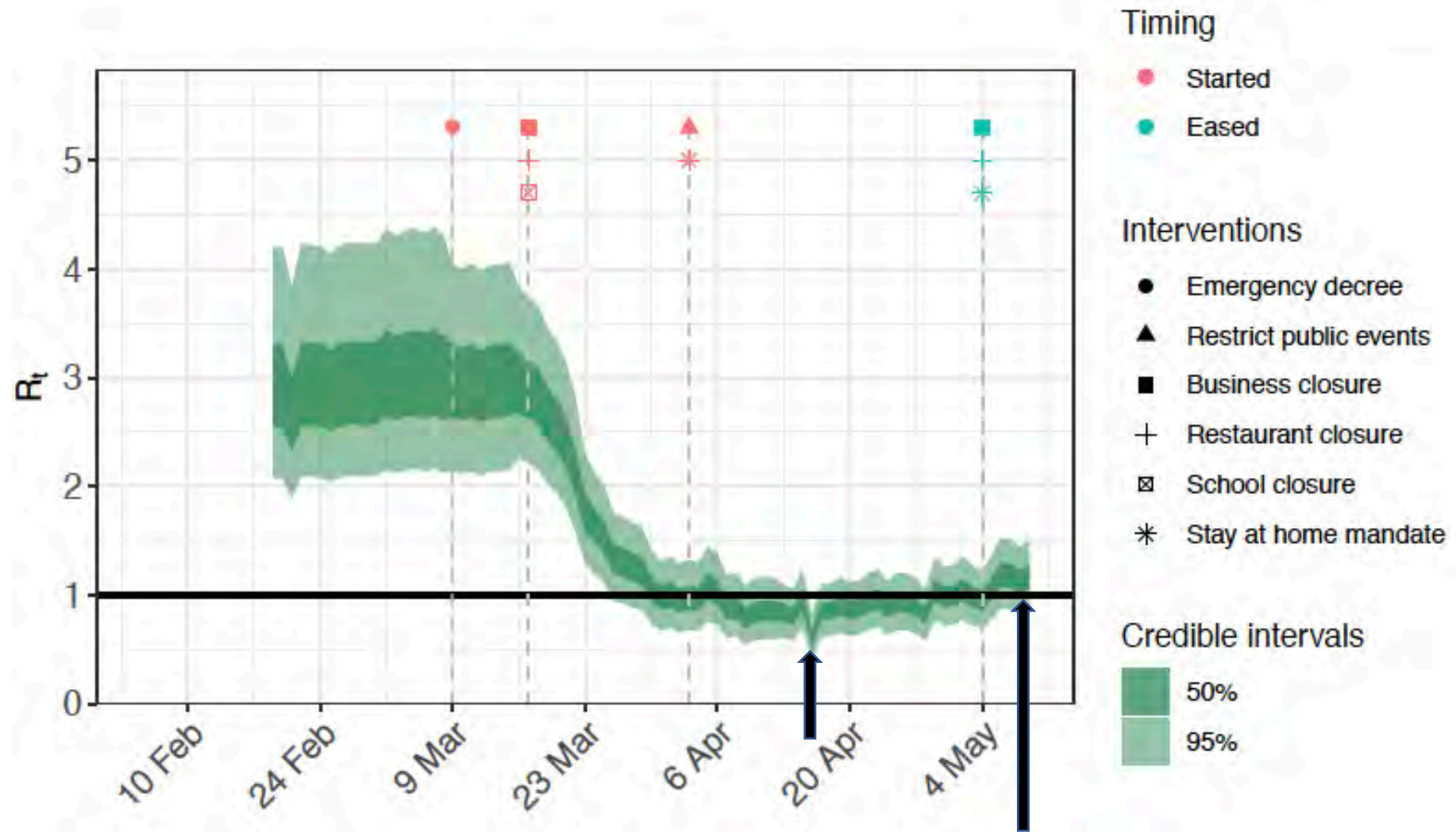
Trends in R_0 by State

Better



Worse





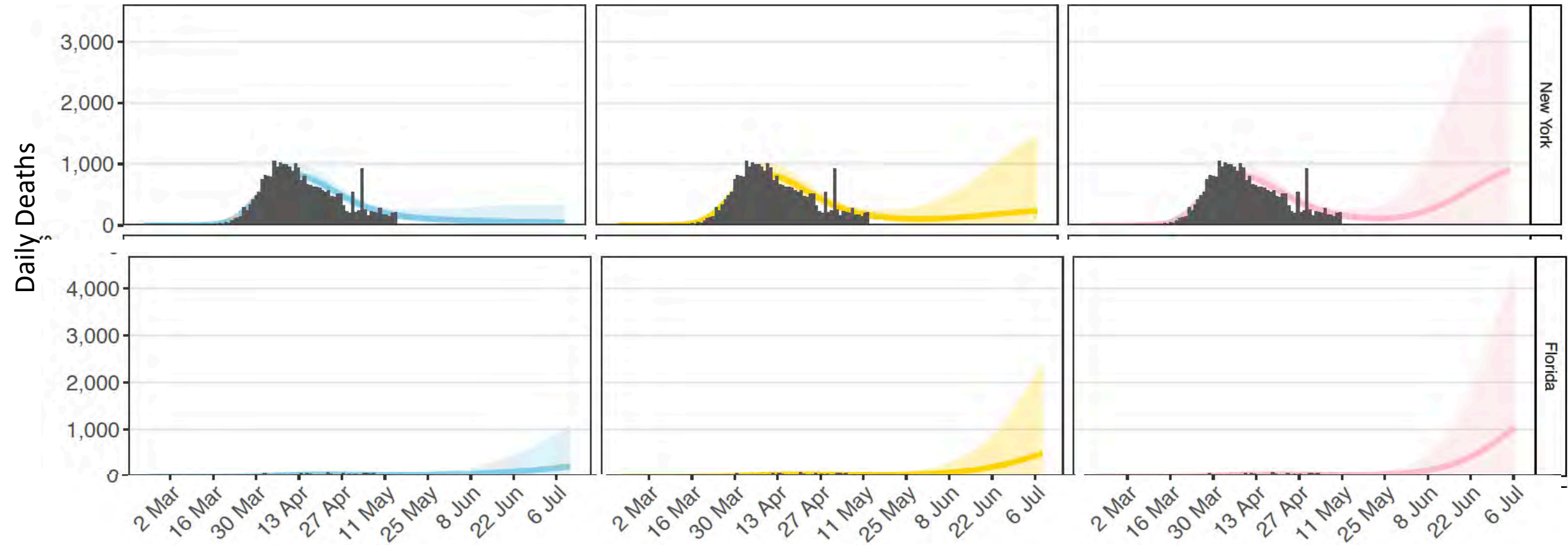
Increases in mobility increased Ro 1.2

Effects of Mobility on Daily Deaths Due to COVID-19

Mobility unchanged

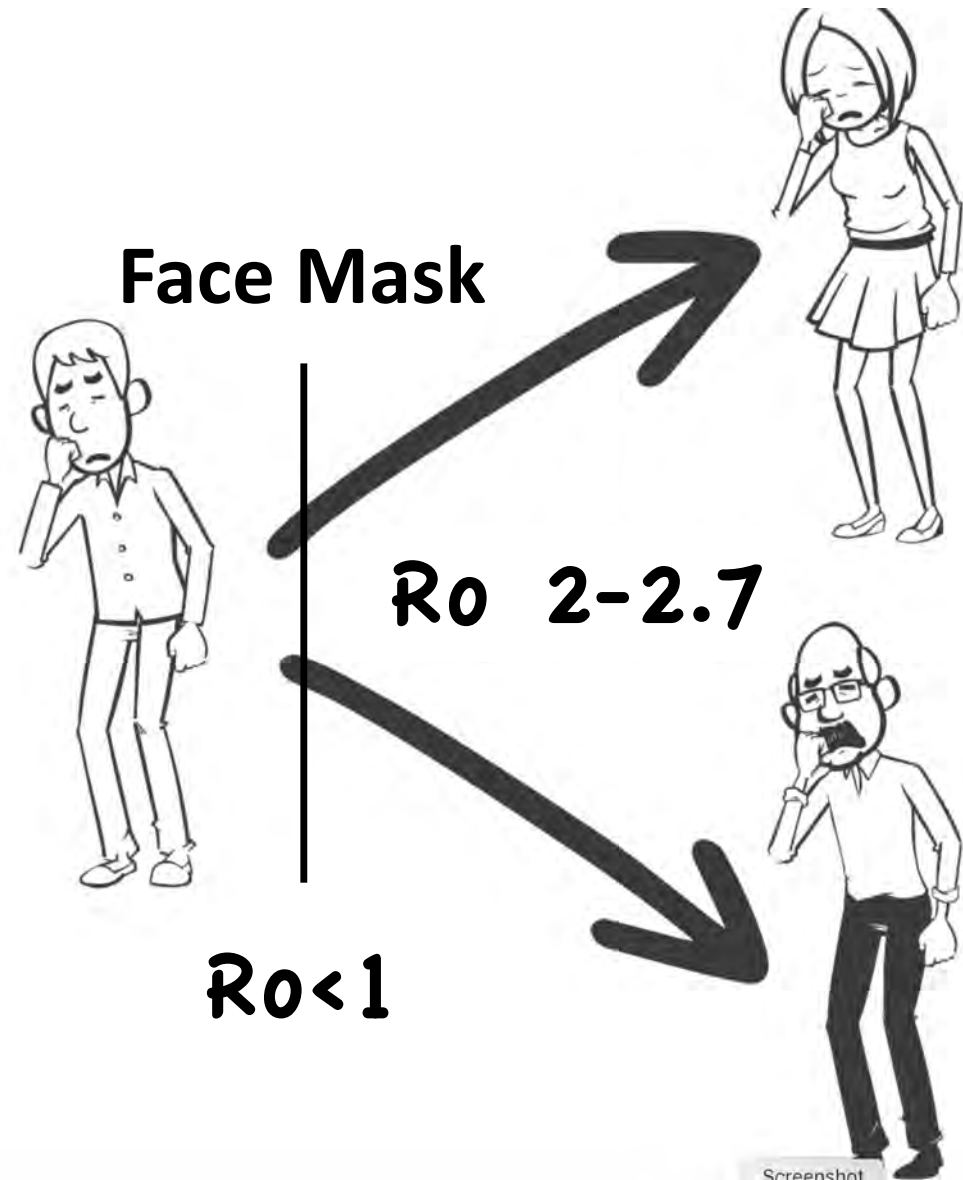
Moderate Increase 20%

Mobility Increase 40%



Transmission

- Infected host can infect 2.0-2.7 others (R_0) highly infectious
- 10% of close contacts develop the disease
- 80-85% contracted within the family (family clusters)



Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering

TO THE EDITOR: Aerosols and droplets generated during speech have been implicated in the person-to-person transmission of viruses,^{1,2} and there is current interest in understanding the mechanisms responsible for the spread of Covid-19 by these means. The act of speaking generates oral fluid droplets that vary widely in size,¹ and these droplets can harbor infectious virus particles. Whereas large droplets fall quickly to the ground, small droplets can dehydrate and linger as “droplet nuclei” in the air, where they behave like an aerosol and thereby expand the spatial extent of emitted infectious particles.² We report the results of a laser light-scattering experiment in which speech-generated droplets and their trajectories were visualized.

The output from a 532-nm green laser operating at 2.5-W optical power was transformed into a light sheet that was approximately 1 mm thick and 150 mm tall. We directed this light sheet through slits on the sides of a cardboard box measuring 53 × 46 × 62 cm. The interior of the box was painted black. The enclosure was positioned under a high-efficiency particulate air (HEPA) filter to eliminate dust.

When a person spoke through the open end of the box, droplets generated during speech traversed approximately 50 to 75 mm before they encountered the light sheet. An iPhone 11 Pro video camera aimed at the light sheet through a hole (7 cm in diameter) on the opposite side of the box recorded sound and video of the light-

CORRESPONDENCE

generated droplets and to qualitatively describe the effect of a damp cloth cover over the mouth to curb the emission of droplets.

Philip Anfinrud, Ph.D.
Valentyn Stadnytskyi, Ph.D.

National Institutes of Health
Bethesda, MD

Christina E. Bax, B.A.

Perelman School of Medicine at the University of Pennsylvania
Philadelphia, PA

Adriaan Bax, Ph.D.

National Institutes of Health
Bethesda, MD

Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

This letter was published on April 15, 2020, at NEJM.org.

1. Duguid JP. The size and the duration of air-carriage of respiratory droplets and droplet-nuclei. *J Hyg (Lond)* 1946;44:471-9.
2. Marr LC, Tang JW, Van Mullekom J, Lakdawala SS. Mechanistic insights into the effect of humidity on airborne influenza virus survival, transmission and incidence. *J R Soc Interface* 2019;16(150).
3. Asadi S, Wexler AS, Cappa CD, Barreda S, Bouvier NM, Ristenpart WD. Aerosol emission and superemission during human speech increase with voice loudness. *Sci Rep* 2019;9:2348.
4. Chao CYH, Wan MP, Morawska L, et al. Characterization of expiration air jets and droplet size distributions immediately at the mouth opening. *J Aerosol Sci* 2009;40:122-33.

DOI: 10.1056/NEJMc2007800

Laser Light-Scattering Experiment Showing Speech-Generated Droplets.



Face Shields

- Block droplets
- Comfortable
- Reusable
- You can see her face!

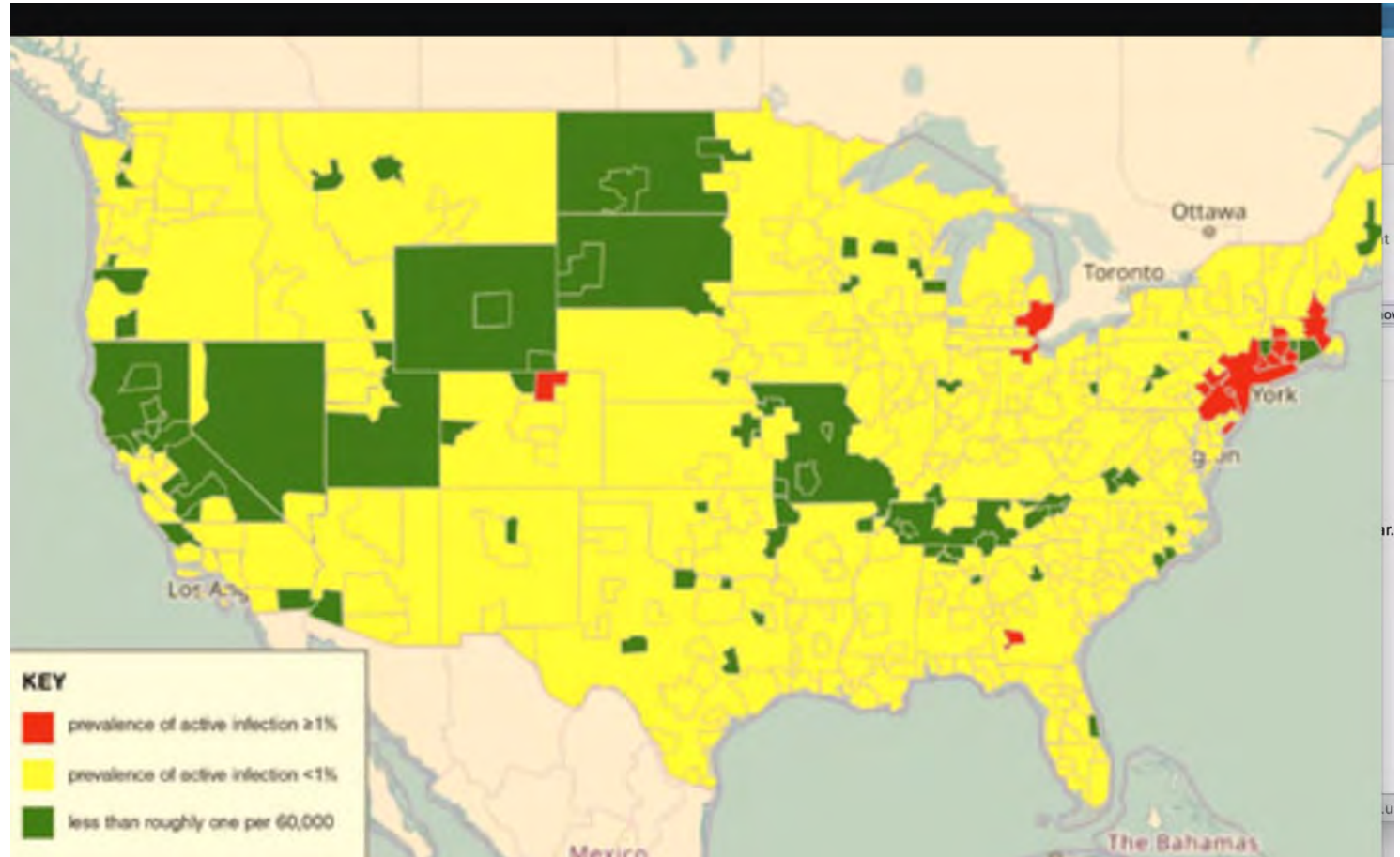


Other preventative measures

- Screen all participants
 - Who should be tested? It depends
 - Syndromic and epidemiology questions
 - Temperature (ideally monitored 2 x daily, scan at entry)
- Gatherings should be as small as possible (50-100 max)
 - 1/50 individuals on average are infected
 - Larger the crowd the more likely it will include infected individuals
- Distancing of 6 ft
- High ceiling rooms, the larger the better.
- Ventilation -bring air from outside in (3 volumes/hour or higher)
- Plastic barriers if area where frequent face to face interactions
- Outside is best! Few documented cases of spread from outside

Zone Approach

- **Red** > 1% of population infected
ie > 100/100,000
- **Yellow** < 1% or below 100/100,000
- **Green** < 1/60,000 or 1.7/100,000



Summary SARS-Cov-2 Prevention

- PCR is the test of choice for determining whether or not someone is actively infected
- Ab levels indicate past infection +/- protection
- Vaccine is 18 months away until then nonpharmacologic methods
- Shelter at home reduced the R_0 to <1 in Florida temporarily
- Increased movement = increase R_0 . Now at 1.2 Rising on West Coast
- Screening with temperature and syndrome inquiry
- Masks or Face Shields for everyone in public closed spaces
- Distancing of 6 ft
- Large high ceiling spaces with good ventilation
- Outdoors when possible.