

Modeling to mitigate COVID-19

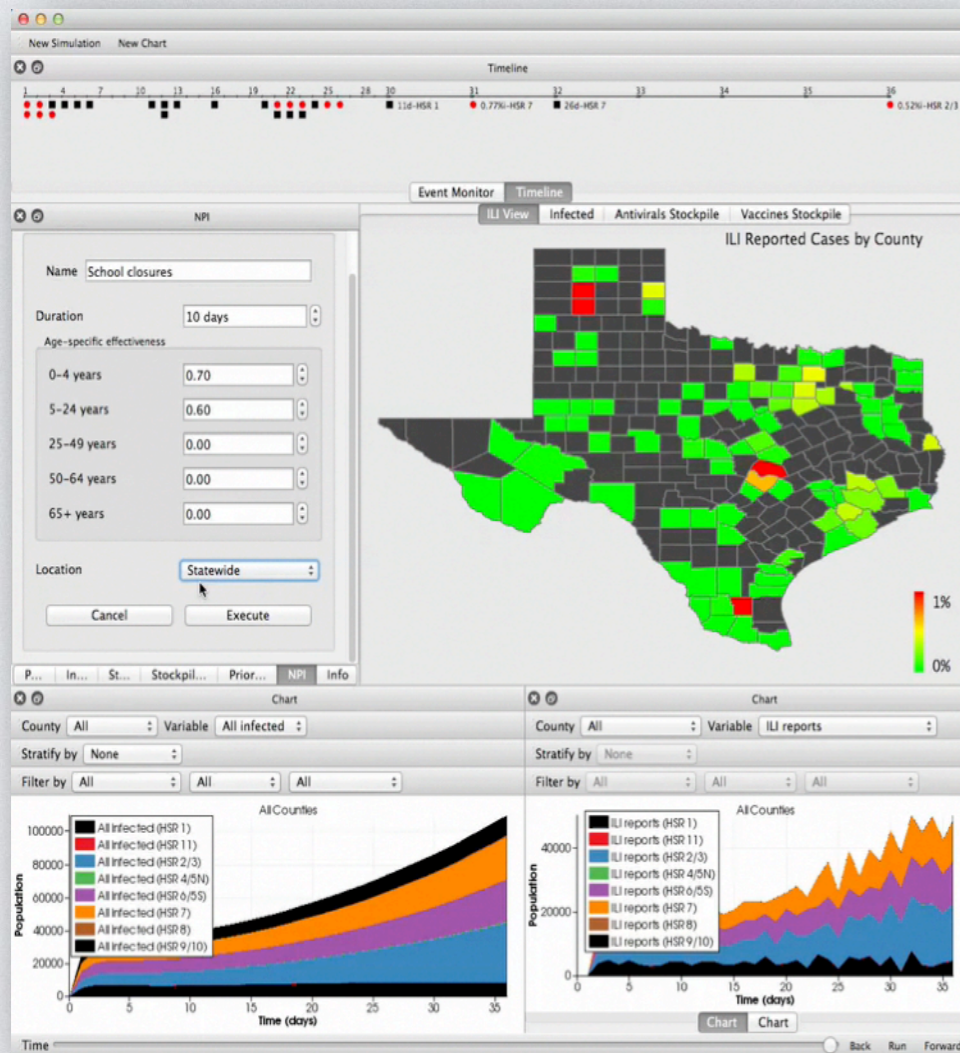
Lauren Ancel Meyers
UT COVID-19 Modeling Consortium

August 14, 2020

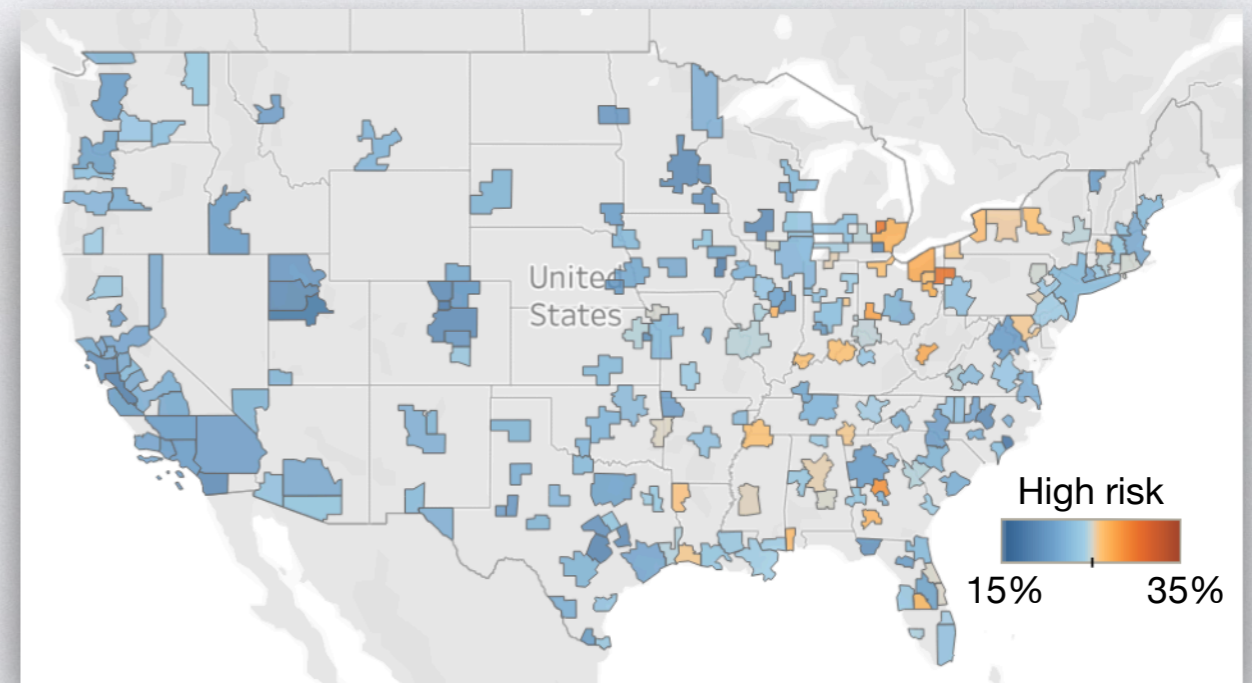


Background

Pandemic Exercise Tool (2013)



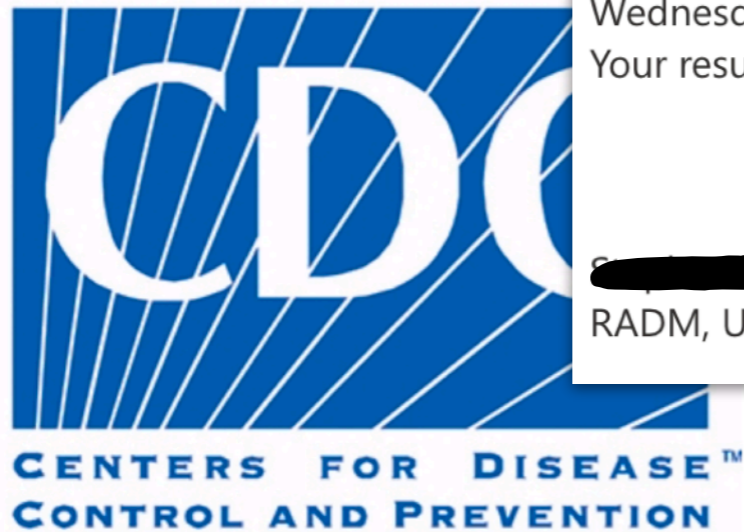
CDC FluCode - Pandemic Model (2020)



Decision support

Subject: Urgent modeling request

This will be a time sensitive and urgent request. Below please see the series of parameters and outcomes we would like you to model. We will need whatever results you can achieve by the close of business Wednesday, east coast US time, or opening of business on Thursday. Your results in that timeframe will inform US policies.

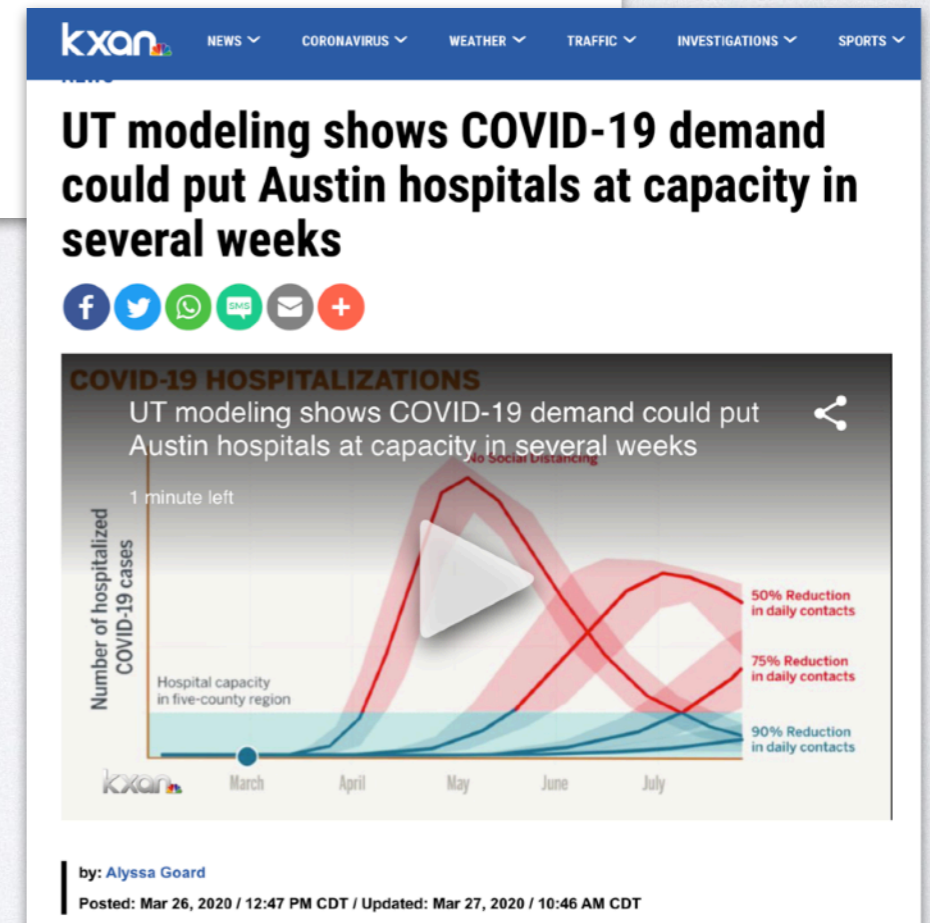


[REDACTED]
RADM, USPHS

Centers for Disease Control and Prevention

National Center for Immunization and Respiratory Diseases Extramural Research Program
Office

Network of Modeling Centers to Improve Evidence Base for Seasonal and Pandemic Influenza
Prevention and Control
RFA-IP-20-003



Public outreach

ENGLISH ESPAÑOL 中文 PLAY THE CROSSWORD Account

Monday, April 6, 2020 Today's Paper

World U.S. Politics N.Y. Business Opinion Tech Science Health Sports Arts Books Style Food Travel Magazine T Magazine Real Estate Video

The Daily Listen to 'The Daily' A historic unemployment crisis.

'On Tech With Shira Ovide' It's now Amazon's turn in the spotlight.

Listen to 'Still Processing' Why 'High Fidelity' is the TV reboot we've needed.

S&P 500 +5.64% ↑ Dow +5.70% ↑ Nasdaq +5.69% ↑ 75°F 77° 88° Austin, TX

Hospitals Face Severe Shortages as U.S. Toll Nears 10,000

- As confirmed cases in the U.S. surged past the combined numbers in Italy and Spain, signs that the virus was peaking in some places helped lift stocks.
- Staff and patients are put at risk by the lack of available protective gear, a Health and Human Services watchdog report said.
- Japan was set to declare a state of emergency as new cases rapidly increased in Tokyo and other large cities. Here's the latest.

Live 4m ago 508 comments

How Coronavirus Attacks the Body

Delays and Shortages Exacerbate Testing Gaps in the U.S. A lack of supplies and delayed results are causing problems for many hospitals, even as new and faster tests come onto the market. 17m ago

A New Covid-19 Crisis: Domestic Abuse Rises Worldwide Movement restrictions may be making violence in homes more frequent, more severe and more dangerous. 1h ago

The Times is providing free access to the coronavirus crisis. Start here for a guide to all our coverage. 4m ago

New York Updates: Deaths Remain Flat, but Crisis Is Still Dire, Cuomo Says Gov. Andrew Cuomo said that 599 people had died in the state — about the same as the 594 deaths reported the previous day. Live 17m ago 28 comments

Business Updates: Markets Rally as Wall Street Thinks Positively Investors were cheered by numbers showing that the pace of the virus's spread was slowing in some places in Europe. Live 45m ago 129 comments

Free access: Full coronavirus coverage | The best mask fabric | Guidance on breastfeeding | How to help the helpers

U.S. Does My County Have an Epidemic? Estimates Show Hidden Transmission Even counties that have few reported cases probably already have sustained, undetected outbreaks, a study has found. 3h ago

Opinion Lockdown Can't Last Forever. Here's How to Lift It. We need to hit and release the brakes on physical distancing, again and again, until we safely get to immunity. 9h ago 257 comments

Has Anyone Found Trump's Soul? Anyone? He's not rising to the challenge of the coronavirus pandemic. He's shriveling into nothingness. Frank Bruni

Don't Freak Out About Quarantine Screen Time Andrew Przybylski and Pete Etchells

Join Jennifer Senior to chat about Trump's personality in a time of crisis Jennifer Senior

In Las Vegas, the Coronavirus Odds Are Not in Our Favor Sanya Dosani

'I Have Been Wearing This Surgical Mask for Two Days' Sanya Dosani

Acting Navy Secretary Slams Fired Captain as 'Stupid' Thomas B. Modly's address to the crew of a coronavirus-stricken aircraft carrier was described by one sailor as "whiny, upset, irritated, condescending." 12m ago

The Open Road Calls, but the Authorities Say 'Stop' The U.S. Constitution ensures the "right to travel," but state and local officials are increasingly telling drivers to stay home. 31m ago

Via Cisco Webex Austin, Texas 1:35 PM CT

CORONAVIRUS PANDEMIC

GLOBALLY

TOTAL CASES 2,766,611

DEATHS 194,456

IN THE UNITED STATES

TOTAL CASES 883,826

DEATHS 50,373

SOURCE: JOHNS HOPKINS UNIVERSITY

Professor Lauren Ancel Meyers | Dept. of Integrative Biology, Univ. of Texas at Austin

2:58 21K views

NEWSROOM 2:35 PM ET

Statesman Support your local businesses.

CORONAVIRUS IN CENTRAL TEXAS

Travis County confirmed COVID-19 cases up to 484

Austin health officials reported Sunday that 24 more people in Travis County have tested positive for COVID-19 since Saturday. Apr 5, 2020 at 6:05 PM

- + Coronavirus in Texas: What we know, latest updates
- + FAQ: What are the rules during a 'shelter in place'?
- + Complete coverage: Texas prepares for coronavirus

Austin health officials recommend everyone wear face masks in public Apr 5 at 6:49 PM

Texas tabs Mississippi State's Vic Schaefer to coach its women's... Apr 5 at 2:57 PM

Coronavirus in Texas: 22 more deaths reported statewide; total cases climb... Apr 5 at 1:10 PM

Why are more young people testing positive for COVID-19 in Austin? Apr 4 at 7:05 PM

How to get help in Austin with food, health care, distance coronavirus... Apr 4 at 6:00 PM

Coronavirus creeping undetected through Texas and U.S.

For the 102 Texas counties that, as of Sunday, have not yet reported a confirmed case of COVID-19, there exists a 9% chance that an outbreak of the disease is already underway, according to an analysis of the disease's... Apr 5 at 11:00 AM

Adult Coed Soccer Leagues - Better Refs and Facilities atxsa.com/Leagues/Soccer

CORONAVIRUS

A coronavirus vaccine is being developed in record time. But don't expect that technology. Posted at 8:16 AM

Brexit Zoo tiger becomes first of its kind to test positive for coronavirus, officials say. Posted at 8:01 AM

If you're traveling between states, here's where you'll have to self-quarantine. Posted at 7:51 AM

Matthew McConaughey plays virtual bingo with Board Rock senior living facility.

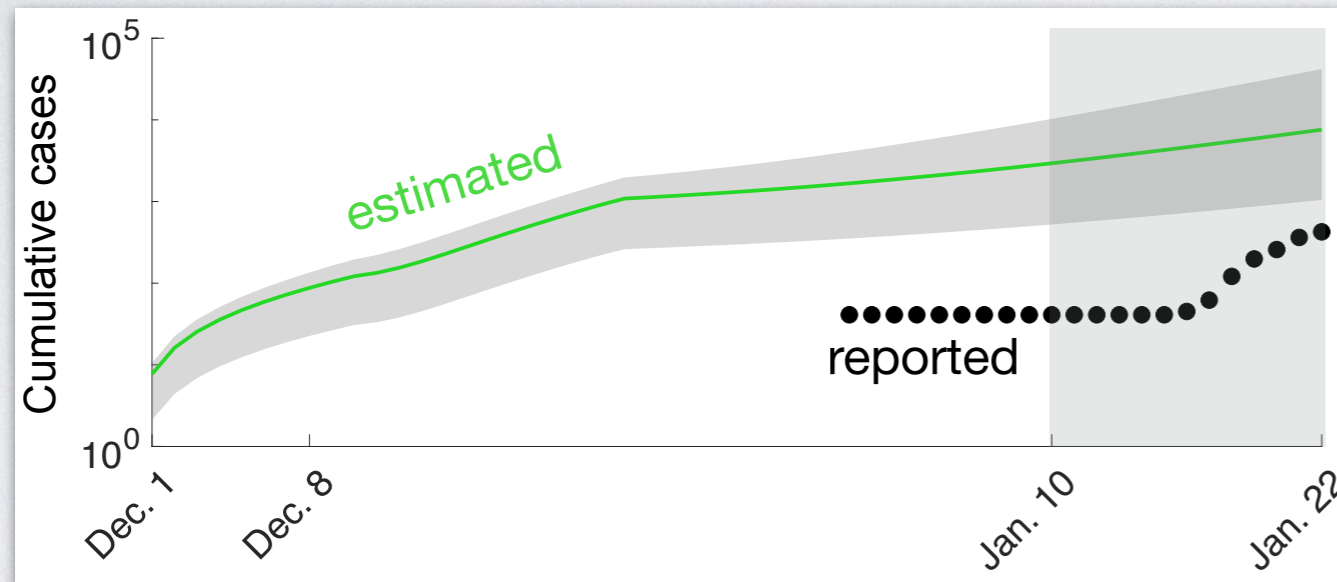
The key questions

Situational awareness Where and how is the virus spreading today?

Forecasting Where will the virus be spreading in the future?

Mitigation How to use limited resources to slow spread and save lives?

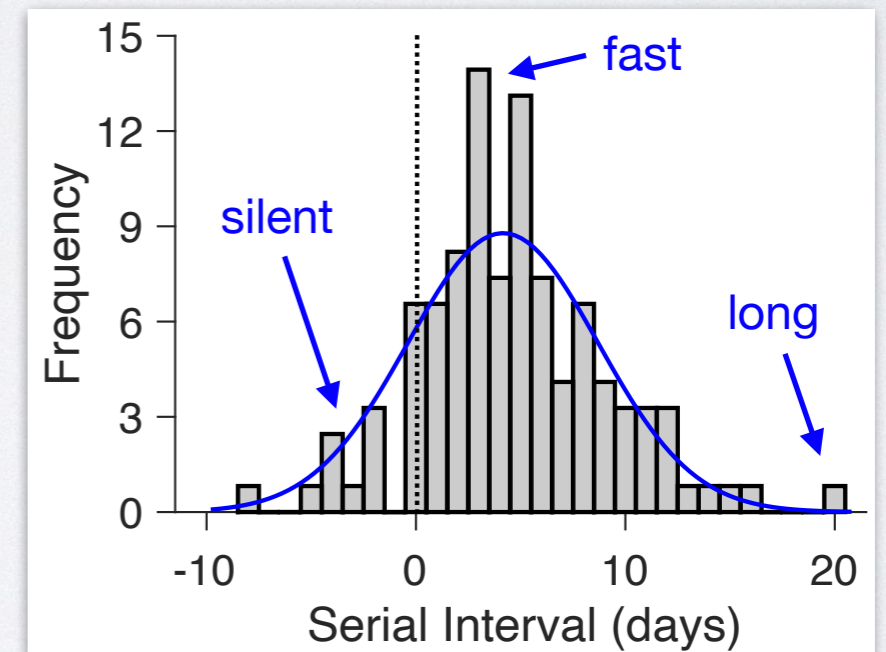
Spread far and fast



12,400 cases

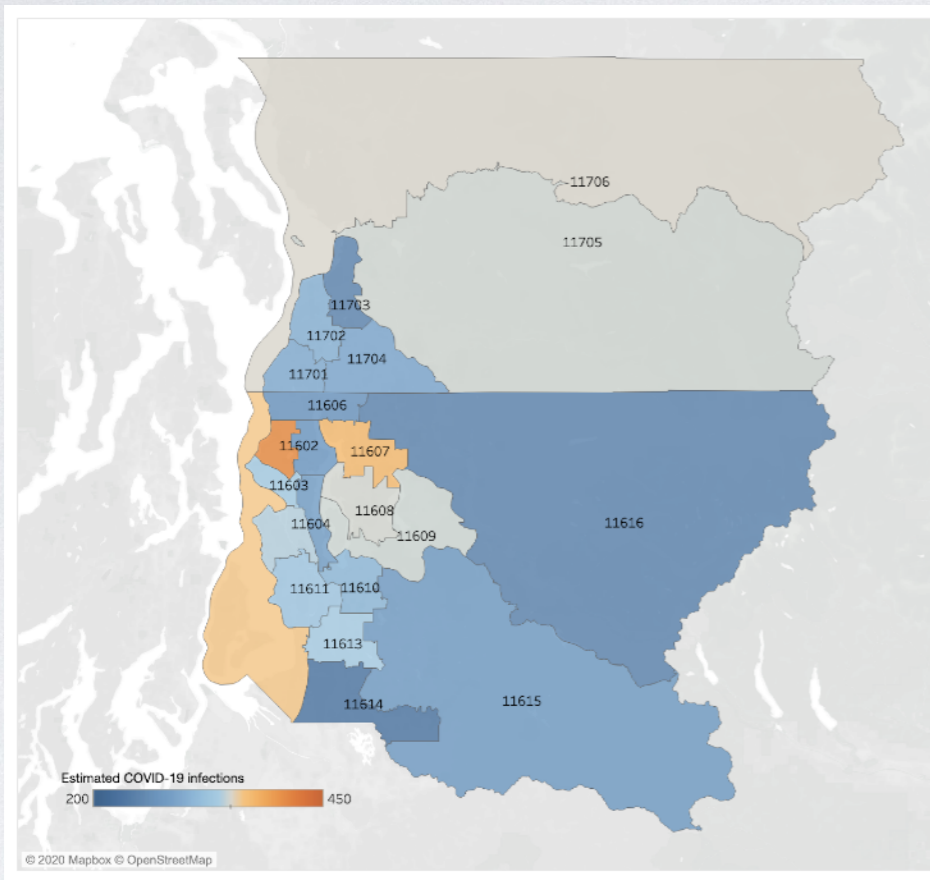
425 cases

Du et al. (2020) Risk for Transportation of 2019 Novel Coronavirus Disease from Wuhan to Other Cities in China. *Emerging Infectious Diseases*



Du et al. (2020) Serial Interval of COVID-19 among Publicly Reported Confirmed Cases. *Emerging Infectious Diseases*

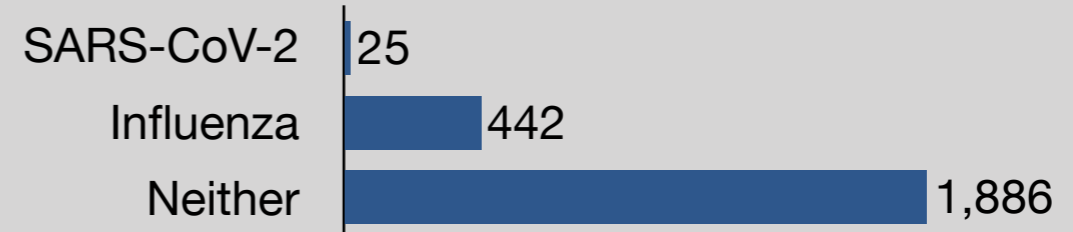
Unseen emergence



Seattle, Washington

First reported January 21, 2020

By March 9th, 245 cases reported



Chu HY et al. Early Detection of Covid-19 through a Citywide Pandemic Surveillance Platform. *N Engl J Med* 2020.

Emergence date:

December 25, 2019 - January 15, 2020

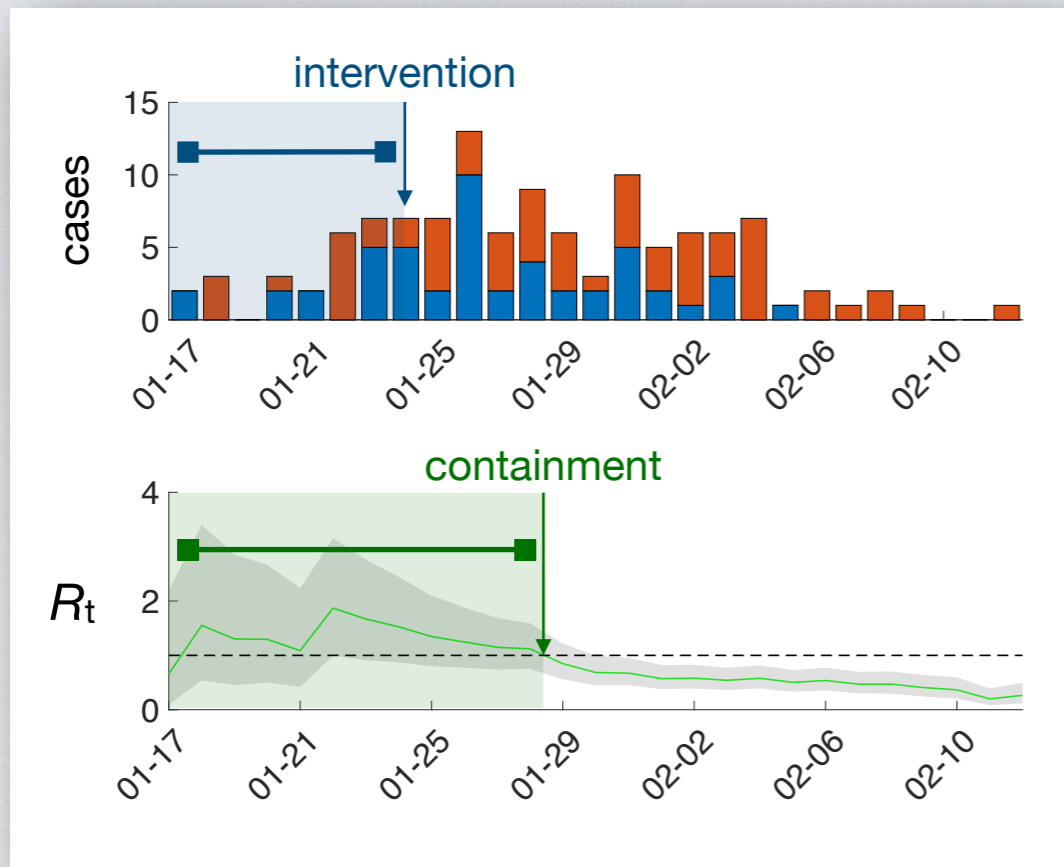
Symptomatic cases prior to March 9:

2810-3404 children

5454-6607 adults

Du et al. (2020) Using the COVID-19 to influenza ratio to estimate early pandemic spread in Wuhan, China and Seattle, US. *EClinicalMedicine*.

Early action matters



A 1-day delay in intervention
prolongs the outbreak by ~2.4 days.

Du et al. (2020) Effects of Proactive Social Distancing on COVID-19 Outbreaks in 58 Cities, China. *Emerging Infectious Diseases*.

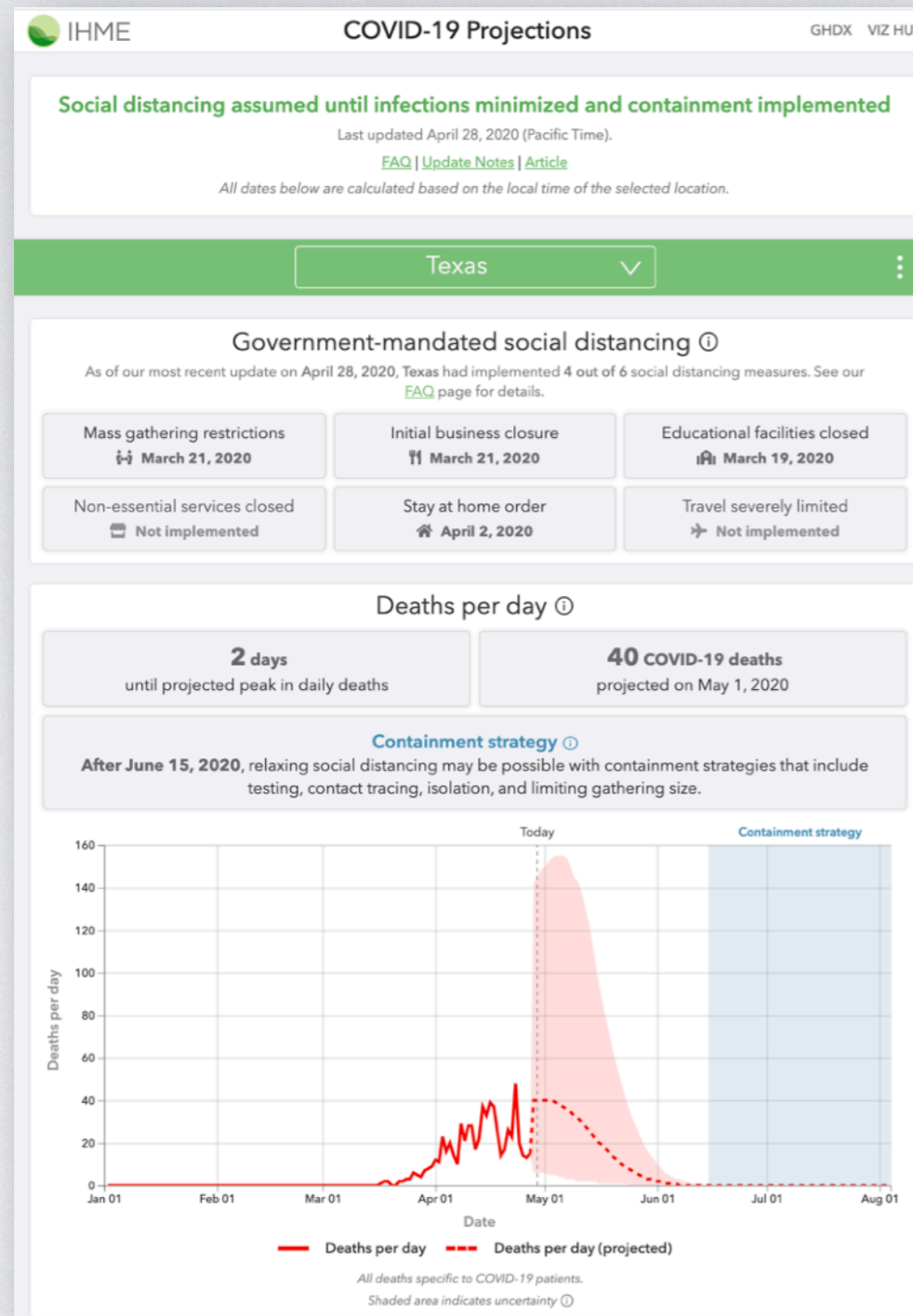
The key questions

Situational awareness Where and how is it spreading today?

Forecasting **Where will it be spreading in the future?**

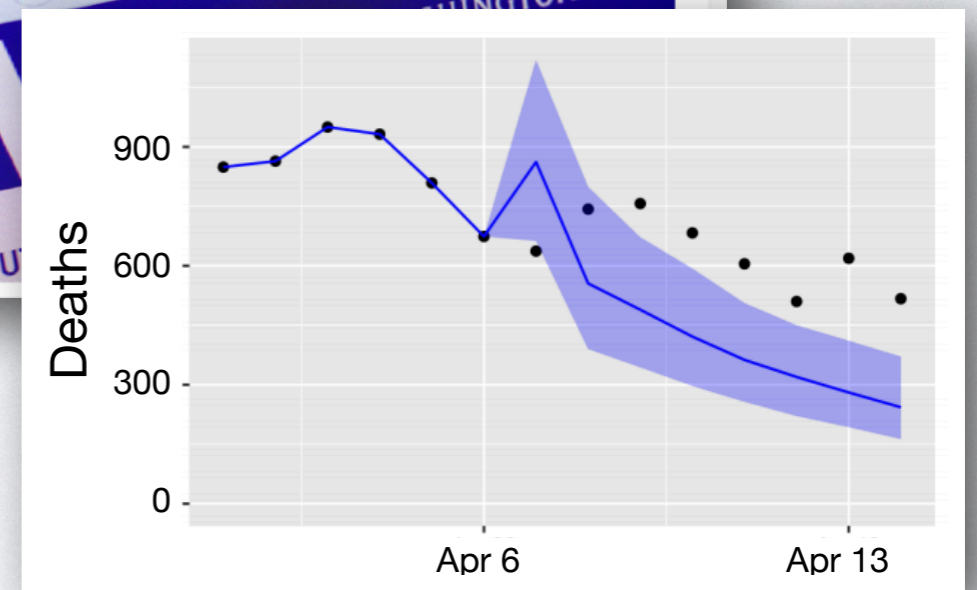
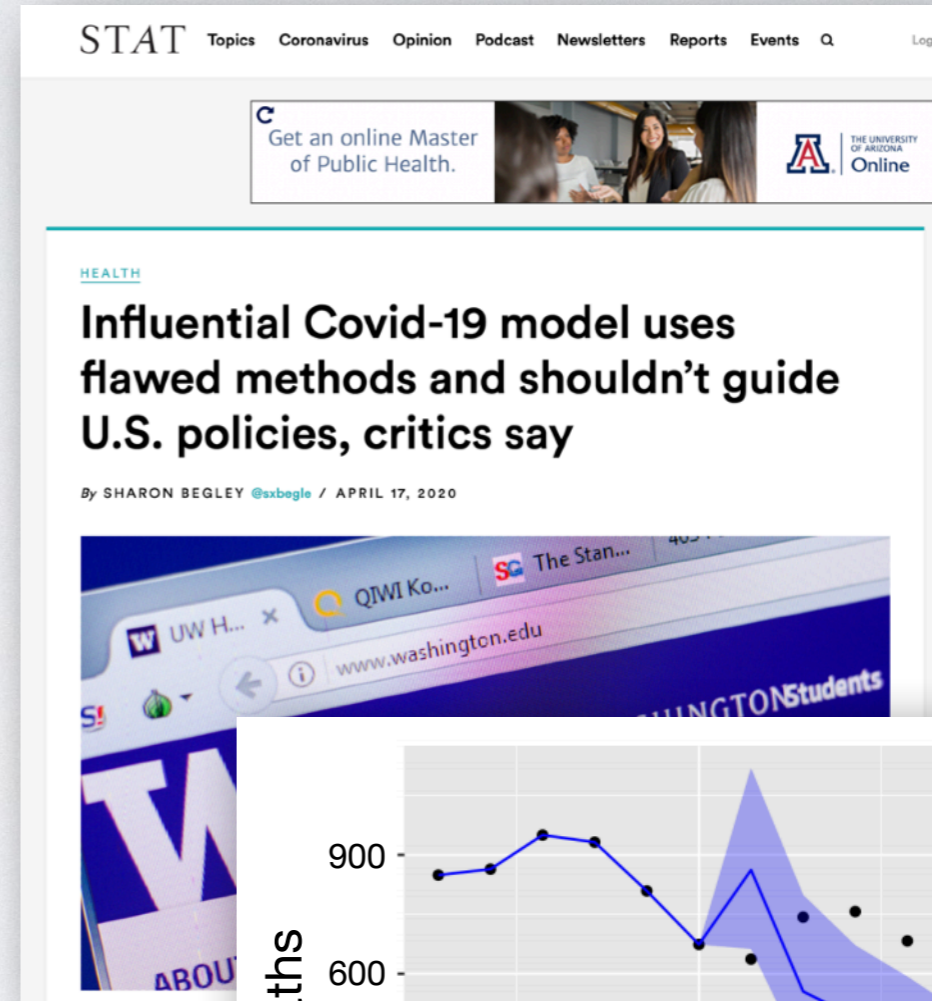
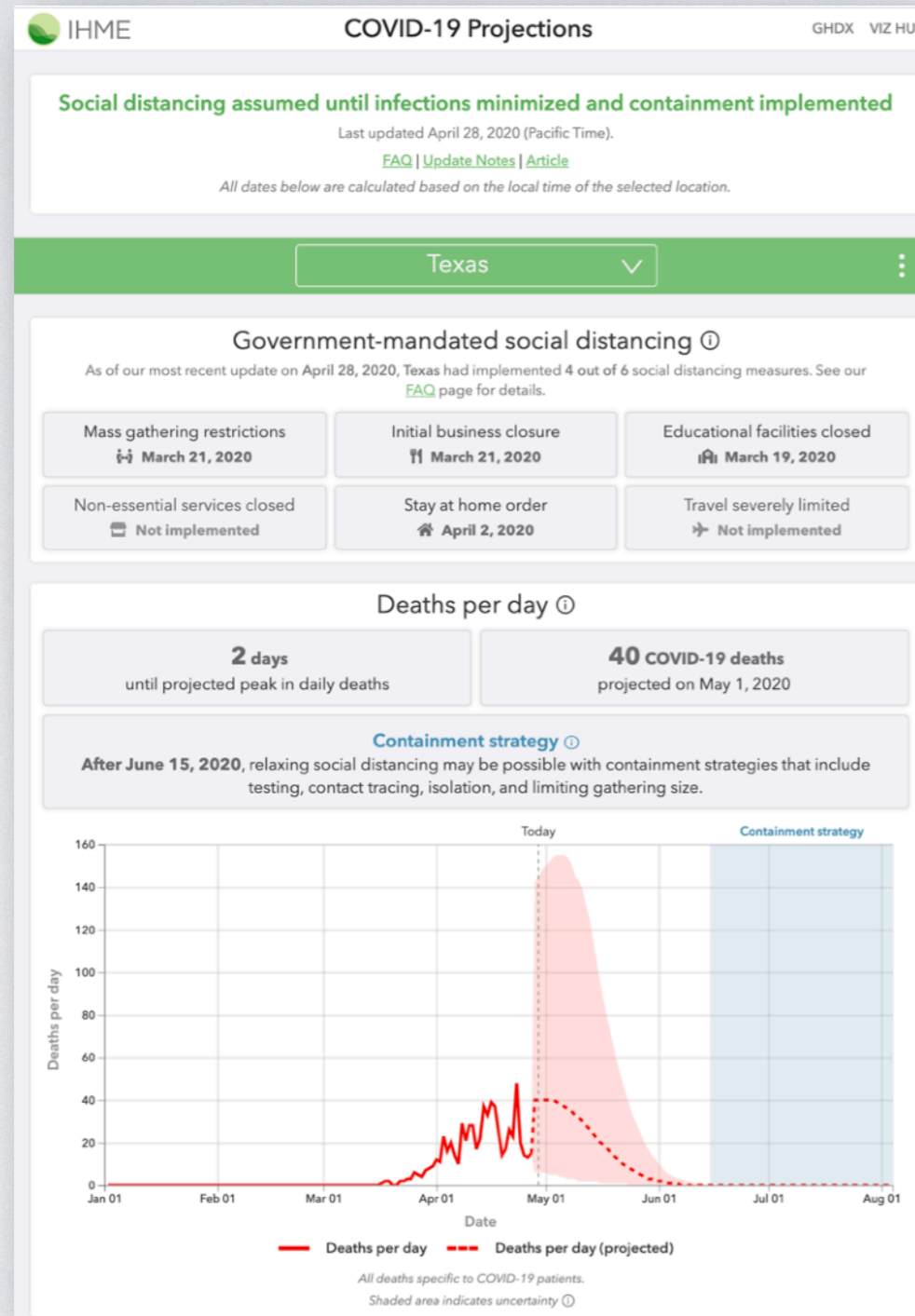
Mitigation How to use limited resources to slow spread and save lives?

The IHME Model



- Deaths will follow a Gaussian curve
- Epidemics in the US will mirror China and Europe
- Social distancing follows state-level orders
- Underestimated uncertainty (fit cumulative data assumed errors are independent)

The IHME Model



Backcast for Spain

Our fix

The University of Texas COVID-19 Modeling Consortium

COVID-19 Mortality Projections for US States and Metropolitan Areas

These graphs show both the reported and projected number of COVID-19 deaths per day across the US and for individual states and metropolitan areas. For each US state, we use local data from mobile-phone GPS traces to quantify the changing impact of social-distancing measures on "flattening the curve."

For more information, please visit our [model FAQ](#).

IMPORTANT NOTE: On 07 May 2020 the New York Times' made substantial changes in how it reports COVID-19 deaths, with a large effect on data New York state in particular. We are working our way through the implications of these changes for our model. In the meantime, we are using data from Johns Hopkins University, which includes both probable and confirmed deaths, to inform our projections.

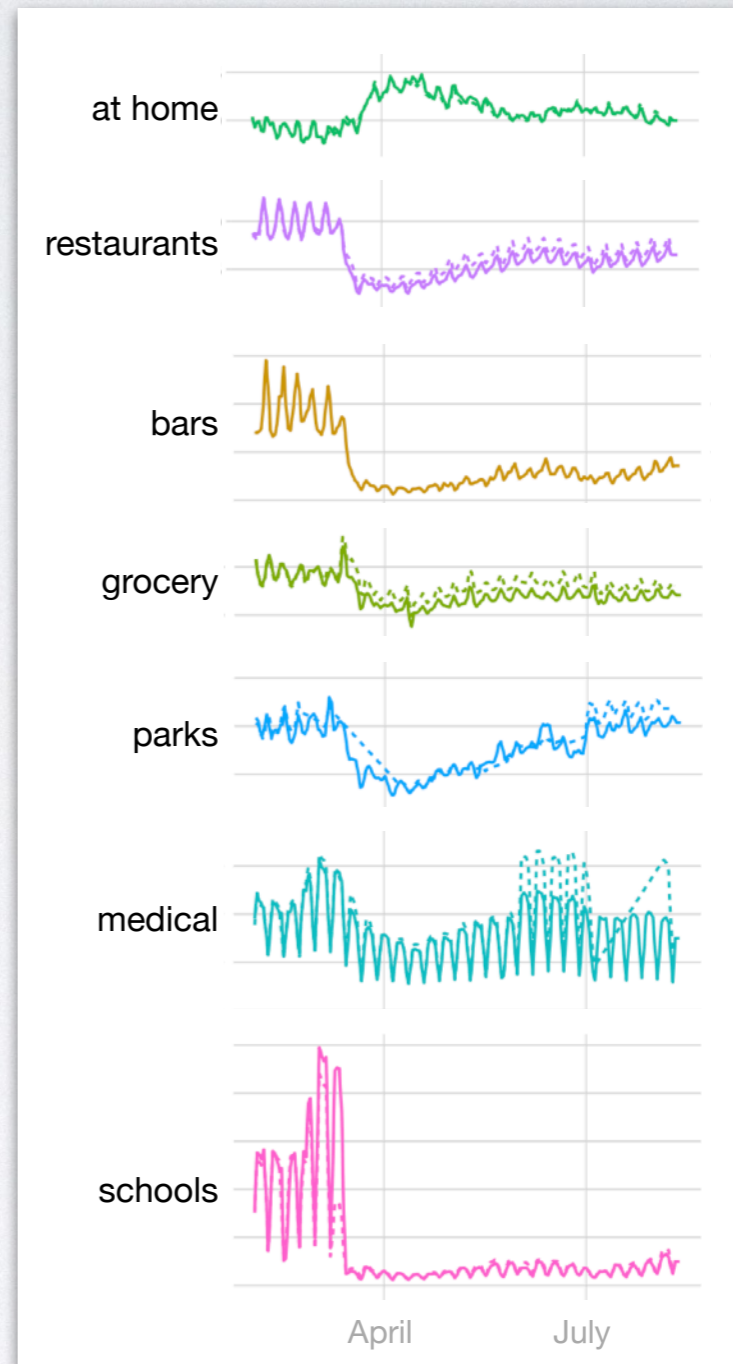
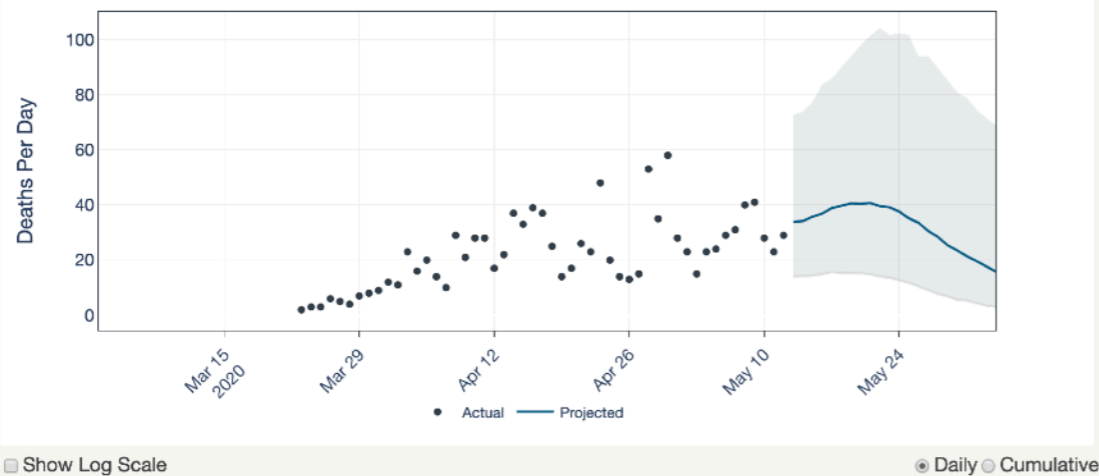
Select State: Select Metro Area:

24% probability that the peak has already passed

57% probability that peak will pass within one week

93% probability that peak will pass within two weeks

Deaths Per Day for Texas



Ensemble forecasting

COVID-19 Forecasts

[Print Page](#)

Updated May 6, 2020

Interpretation of Cumulative Death Forecasts

- National-level forecasts now include fourteen individual forecasts, and all indicate an increase in deaths in the coming weeks. Predicted rates of increase differ among the forecasts, depending on assumptions about the strength and coverage of social distancing behaviors.
- State-level ensemble forecasts (only shown for states and territories with at least two forecasts) indicate that some states may have limited additional deaths in the coming weeks, while substantial increases may occur in others.

On This Page

[National Forecast](#)

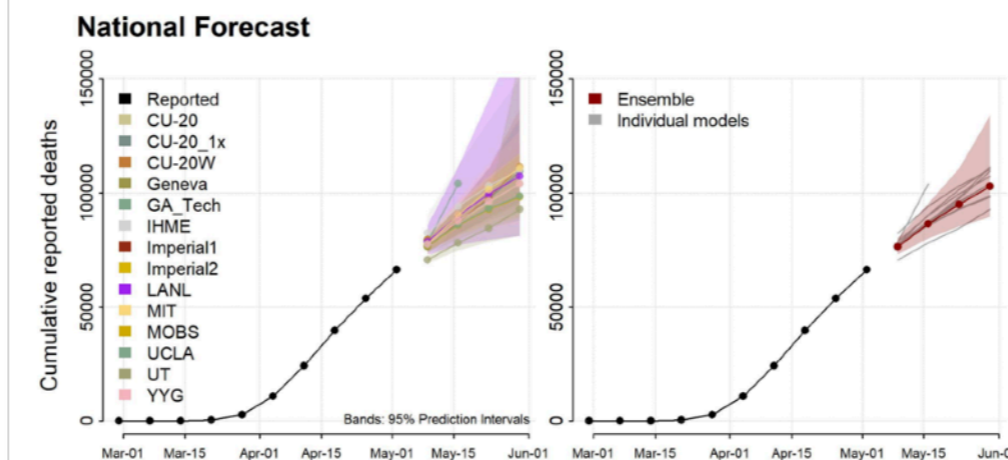
[State Forecasts](#)

[Why Forecasting COVID-19 Deaths in the US is Critical](#)

[What the Forecasts Aim to Predict](#)

[Working to Bring Together Forecasts for COVID-19 Deaths in the US](#)

National Forecast



Why is forecasting so hard?



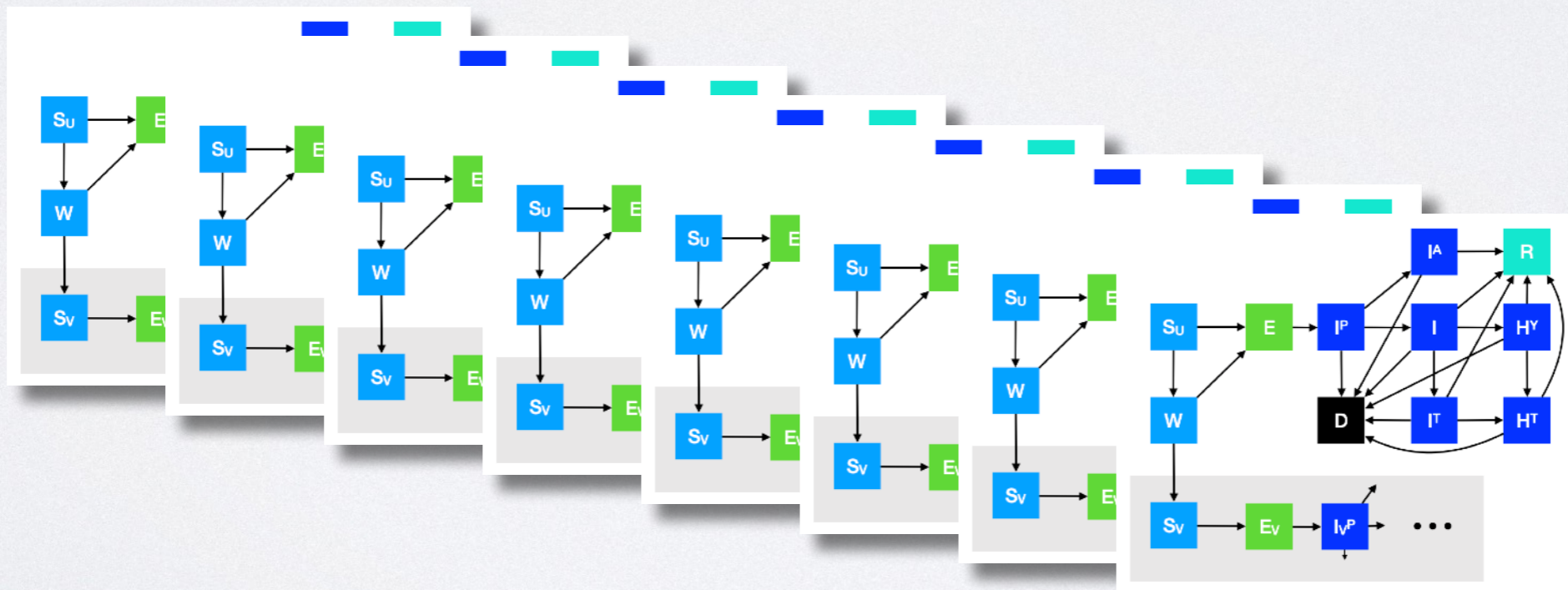
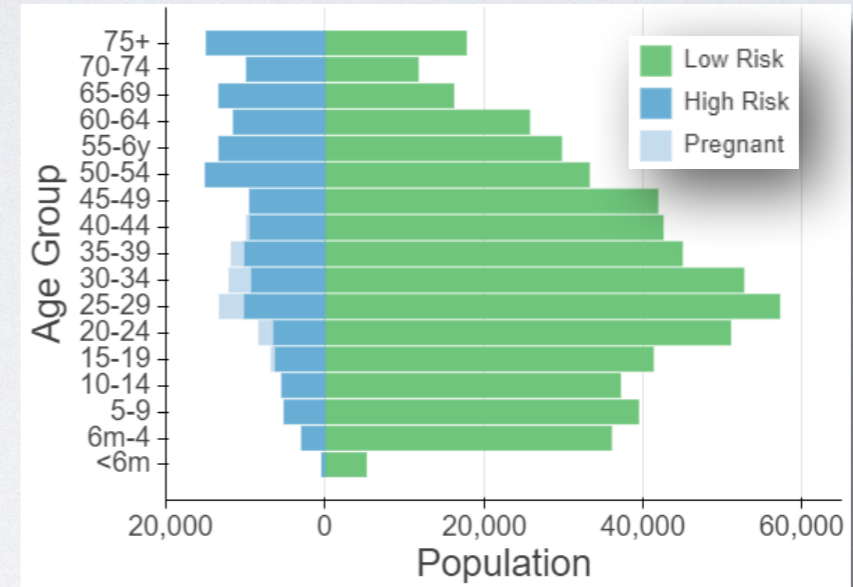
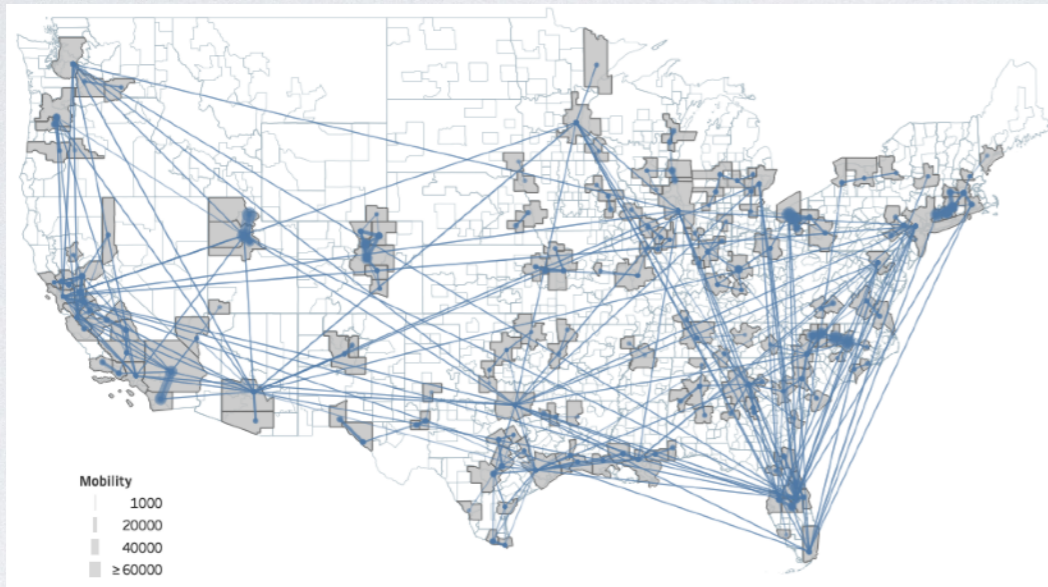
The key questions

Situational awareness Where and how is it spreading today?

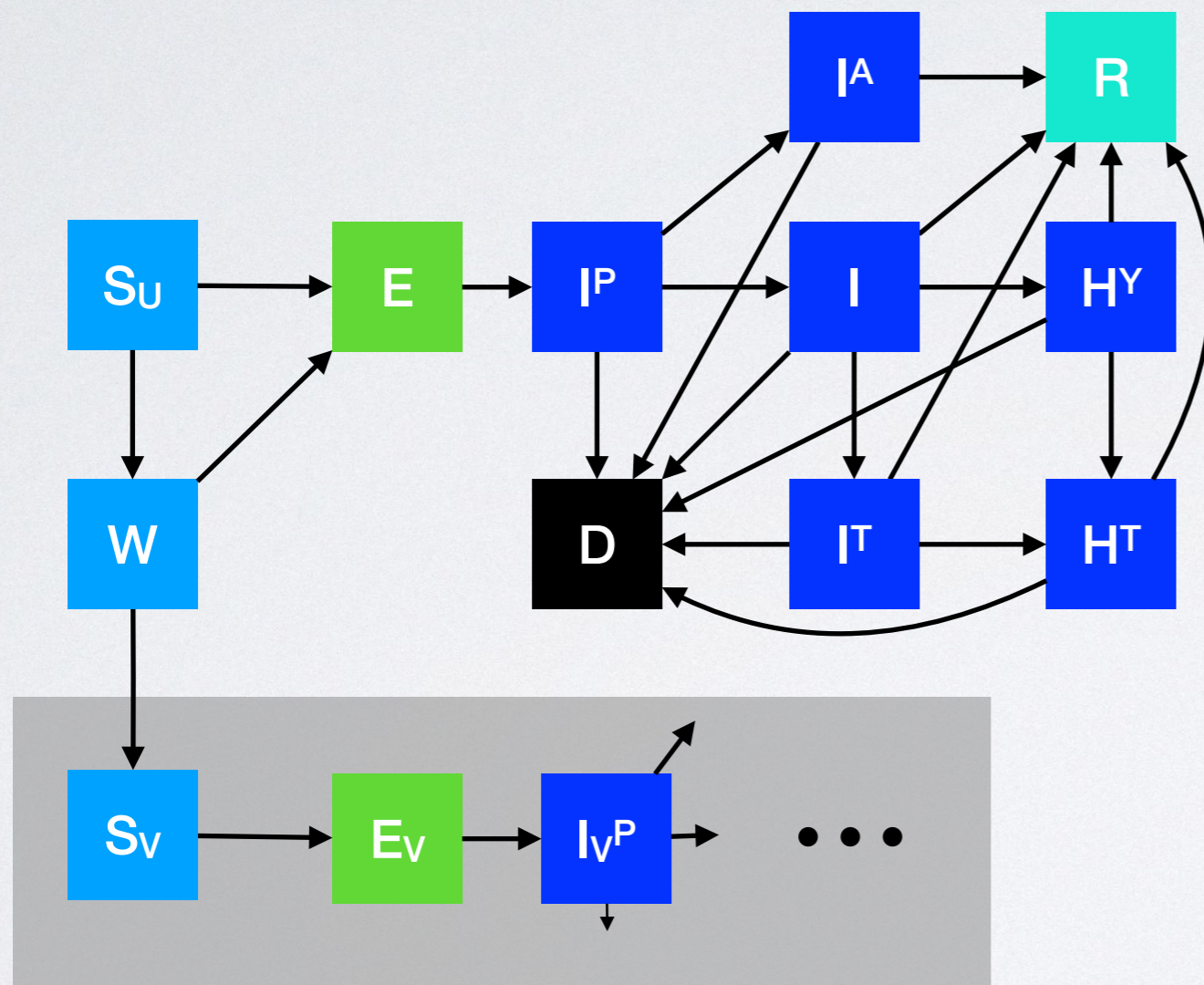
Forecasting Where will it be spreading in the future?

Mitigation **How to use limited resources to slow spread and save lives?**

217 City Model

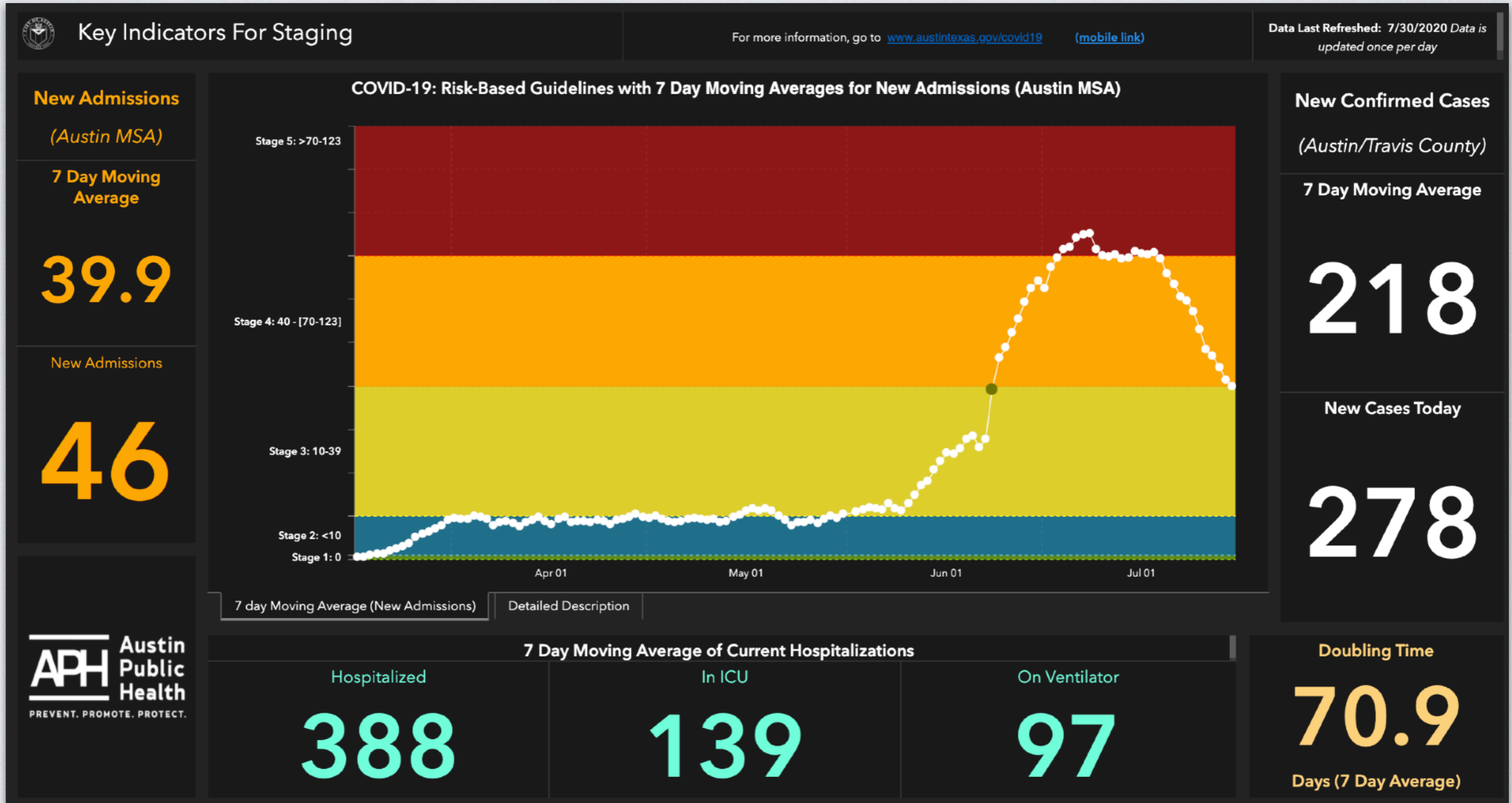


COVID-19 SEIR model



Compartments			
S	susceptible		
W	newly vaccinated (not protected)		
S_v	susceptible and vaccinated		
E	exposed		
I^P	pre-symptomatic		
I^A	asymptomatic		
I	symptomatic	R	recovered
I^T	treated	D	deceased
H^Y	hospitalized (untreated)		
H^T	hospitalized (treated)		

Austin's Play Book



Optimization problem

What were the city's goals?

Avoid overwhelming surge in hospitalizations

Avoid stay-home orders or make them as short as possible

What were the policy options?

Tighten and loosen social distancing measures

What did we recommend?

Track daily COVID-19 hospital admissions

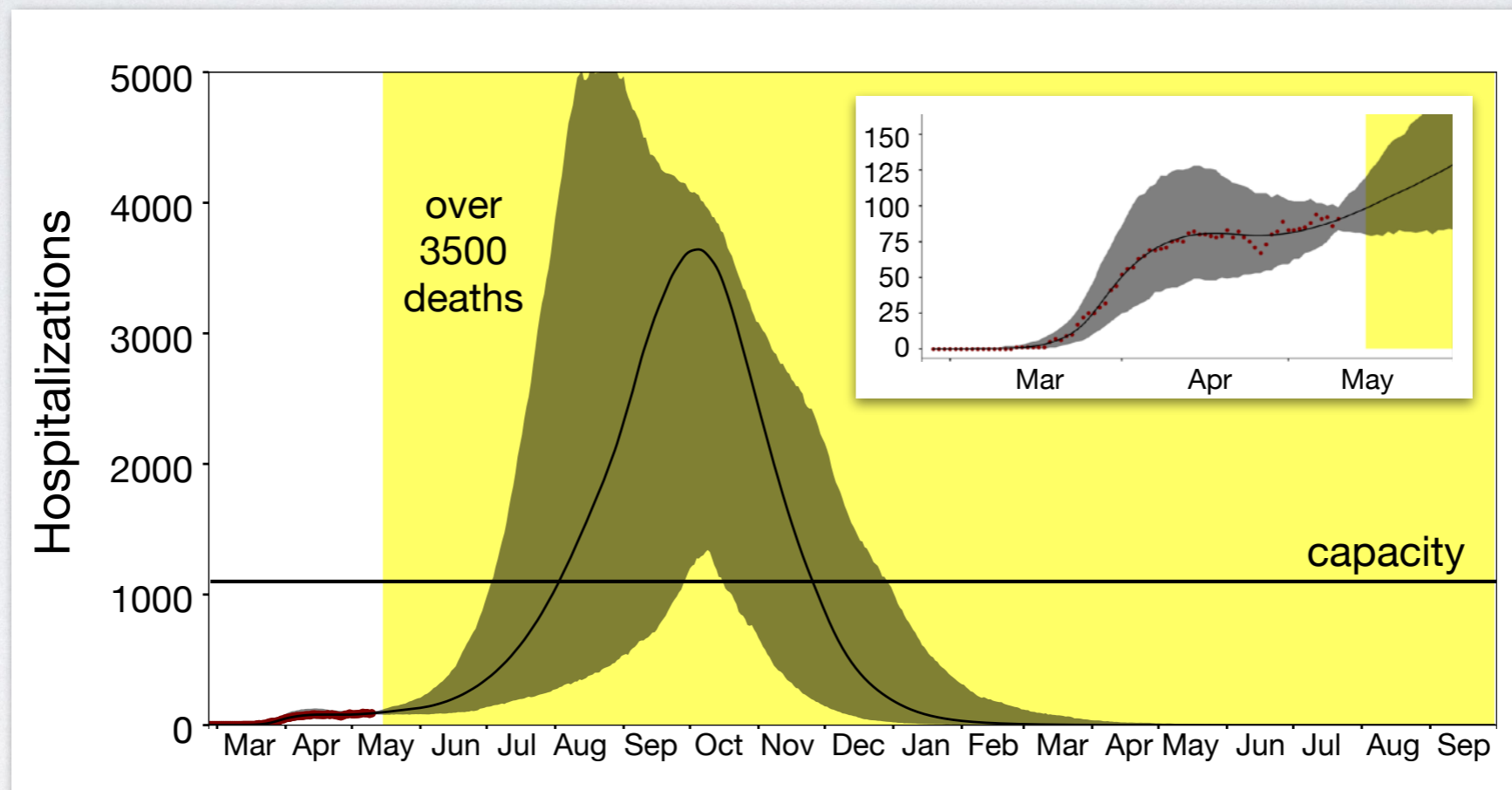
Tap on the brakes when things look bad

Where's the math?

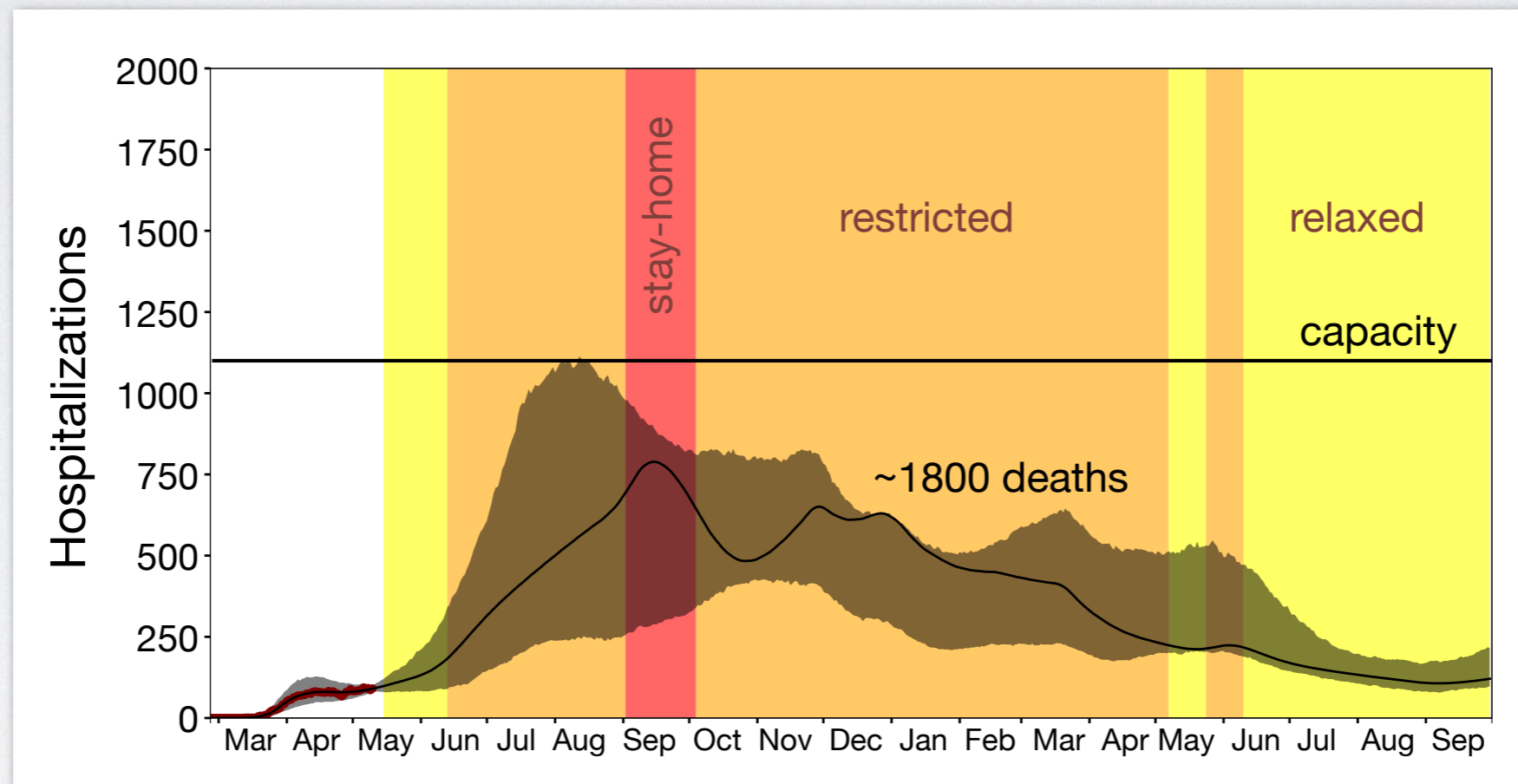
Determining the thresholds

Monitoring the situation

What if we do nothing?



Initial policy projections



Adaptations

PNAS Proceedings of the National Academy of Sciences of the United States of America

Keyword, /

Home Articles Front Matter News Podcasts Autho

NEW RESEARCH IN Physical Sciences Social Sciences

RESEARCH ARTICLE

Timing social distancing to avert unmanageable COVID-19 hospital surges

Daniel Duque, David P. Morton, Bismark Singh, Zhanwei Du, Remy Pasco, and Lauren Ancel Meyers

Safe ICU capacity
Alternative care sites
Flu season
School openings

Tracking COVID-19

The University of Texas COVID-19 Modeling Consortium

Reproduction number $R(t)$
1.07
[0.83 - 1.97]*

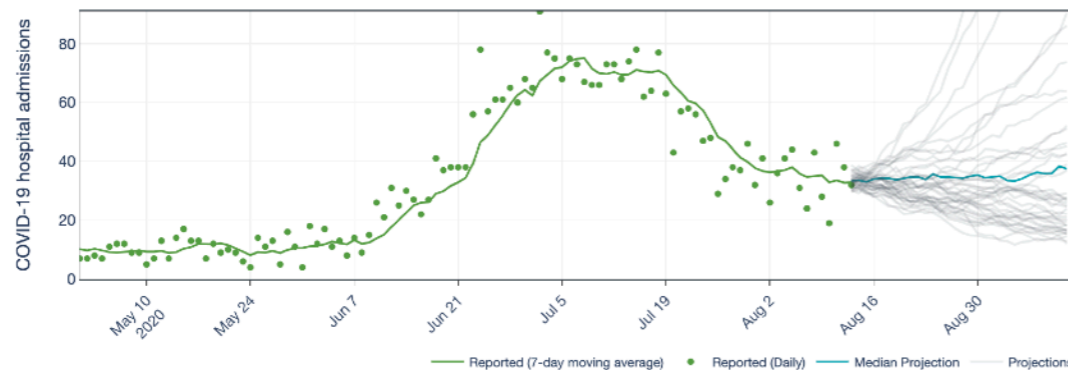
Probability epidemic is growing
72%

Doubling time
22 Days

14-day change
2% more infections

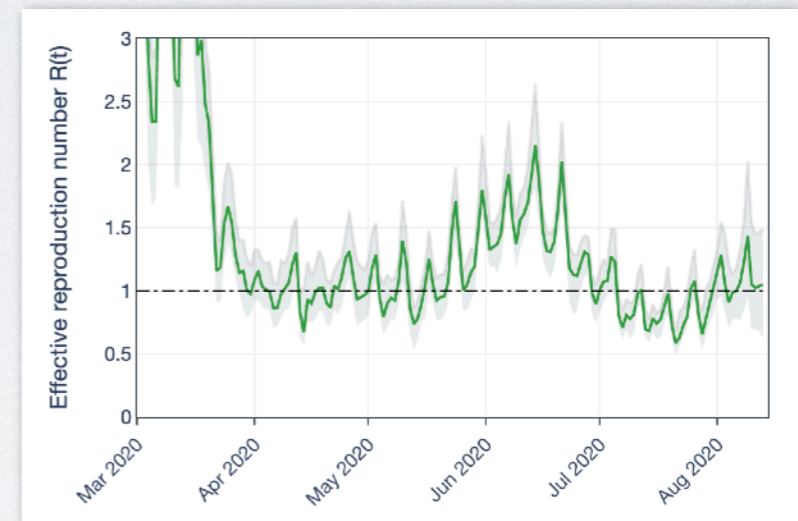
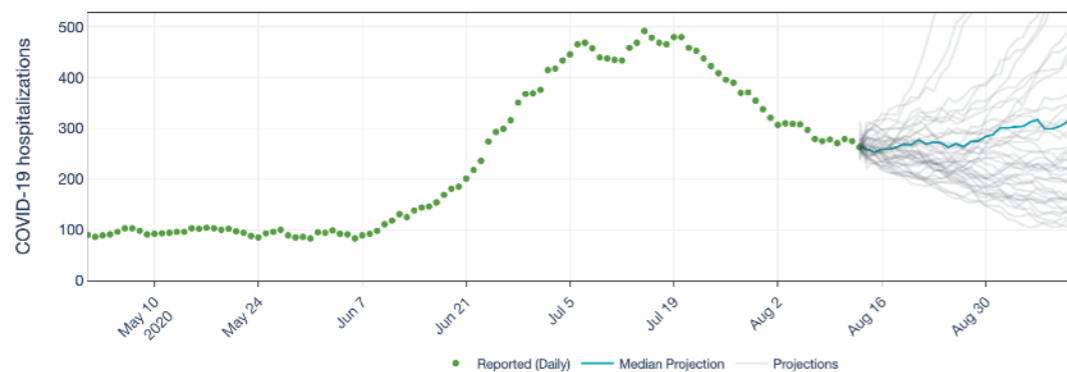
* Numbers in brackets are 95% credible intervals and indicate the uncertainty in model estimates.

Daily COVID-19 Hospital Admissions in the Austin-Round Rock MSA (7 day moving average)



Click and drag on the plot to zoom-in and double-click to zoom-out completely. The icons at the top right of each graph will provide you with additional options.

Daily COVID-19 Hospitalizations in the Austin-Round Rock MSA



Reproduction number

Funding and team

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Simon Cauchemez, Institute Pasteur
Ben Cowling, U Hong Kong
Maytal Dahan, TACC
Oscar Dowson, Northwestern University
Zhanwei Du, UT
Daniel Duque Villarreal, Northwestern
Spencer Fox, UT
Kelly Gaither, TACC
Alison Galvani, Yale
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