

# COVID-19, Predictive Modeling, and Syndromic Surveillance: An Overview

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# Overview

- **COVID-19 in Alaska**
- **Predictive Modeling**
  - **General concepts**
  - **What do the models say?**
- **What's next?**
- **Syndromic Surveillance: An Intro**

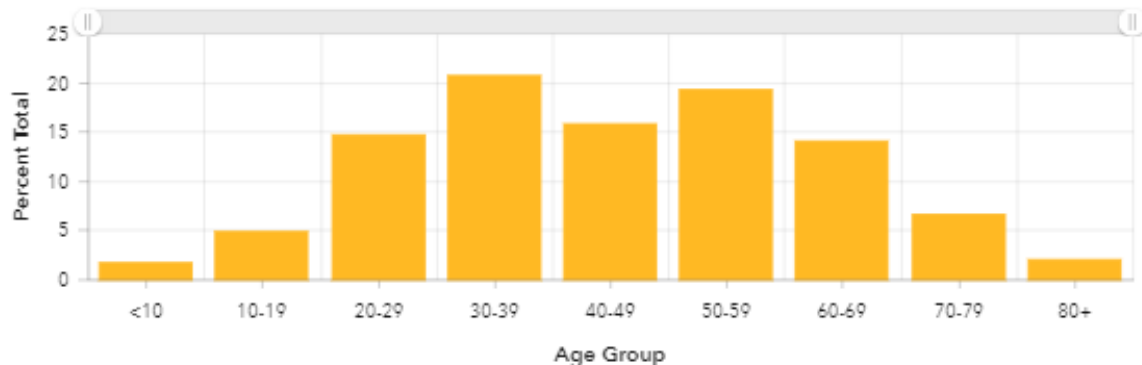


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### Total Statewide Cases by Age Group



Percent by Age Group

Percent by Gender

### Total Cases

# 285

Cumulative (includes recovered cases)

Total Cases

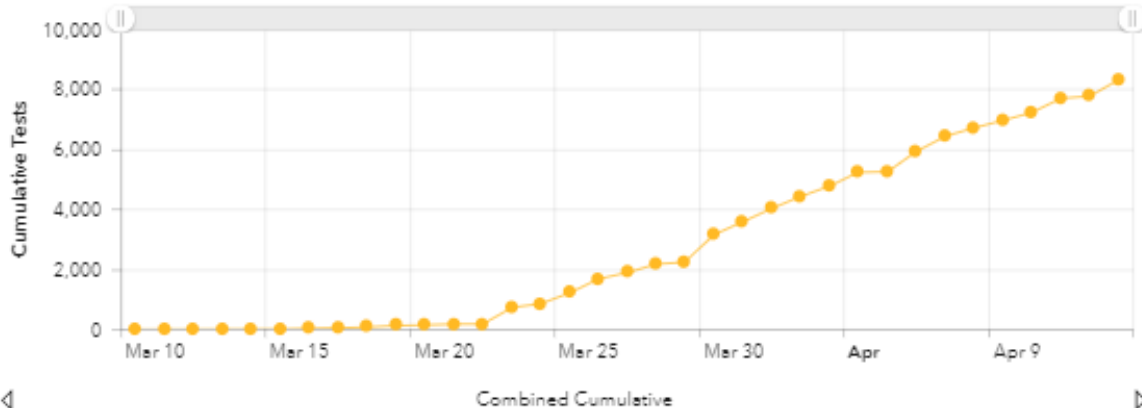
New Cases

### Recovered Cases

# 98

Statewide Totals

### Cumulative Tests by Day (Combined)



### Total Hospitalizations

# 32

Cumulative (does not reflect current stays)

### Deaths

# 9

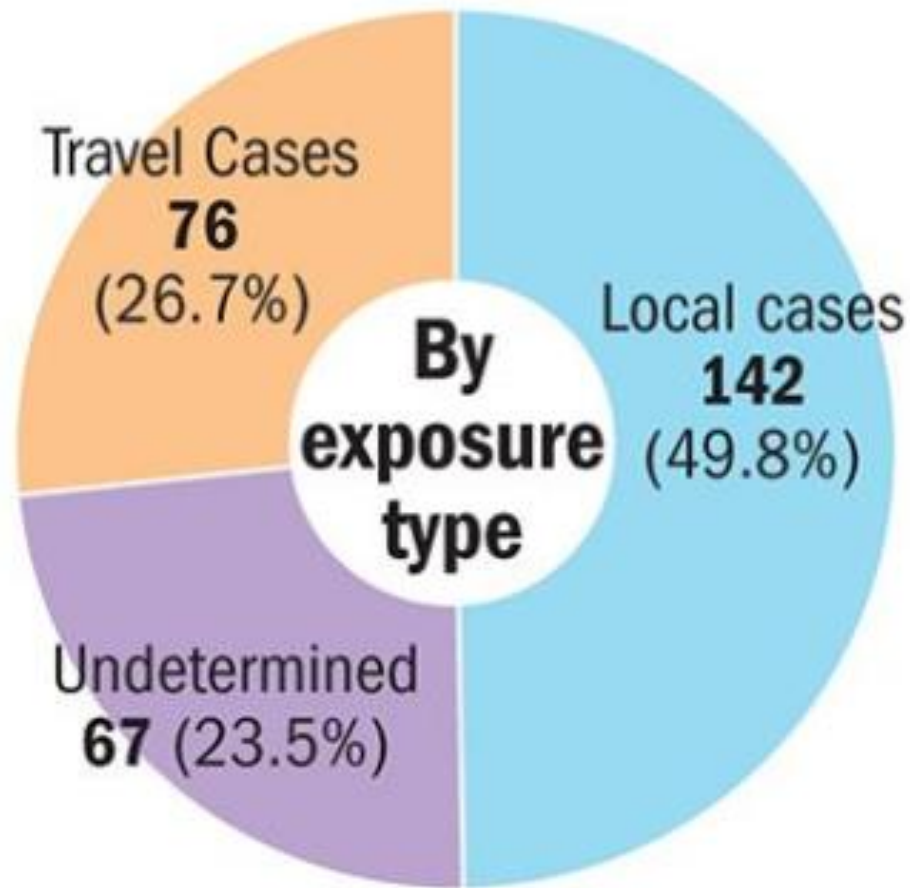
Statewide Totals

Retrieved on 4/15/20 am:

<https://coronavirus-response-alaska-dhss.hub.arcgis.com/>



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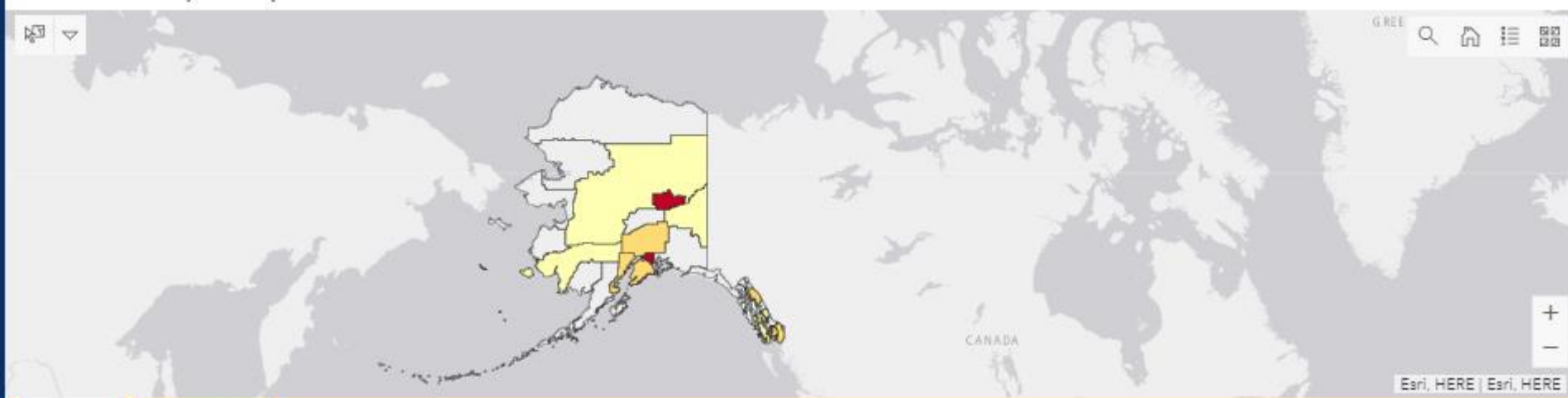
**KEVIN POWELL / Anchorage Daily News**

Source: Anchorage Daily News 4/15/20

Data Source: Alaska Department of Health and Social Services

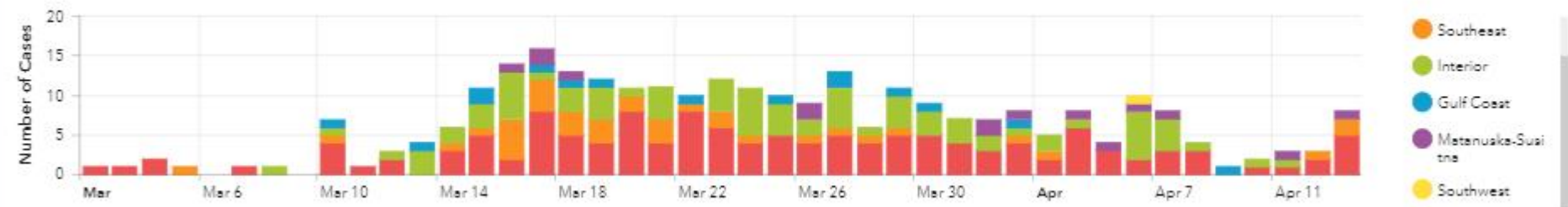


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Cases Map Lab Testing Map

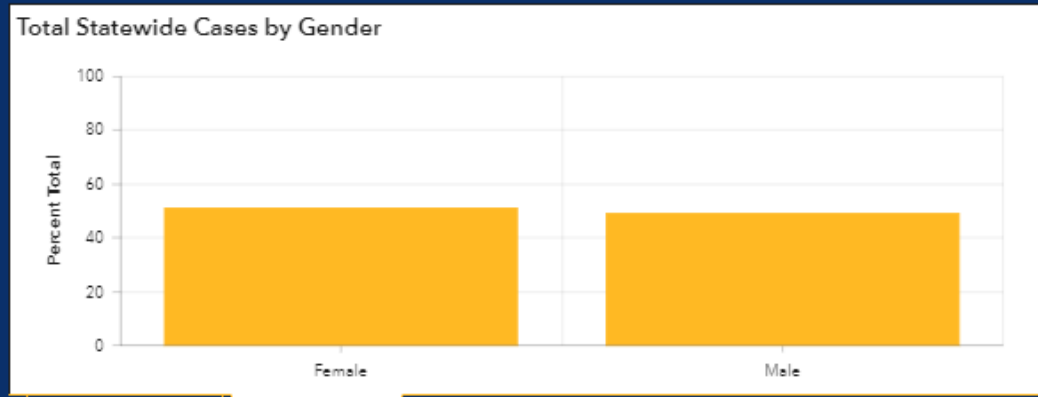
### Laboratory Confirmed Cases of COVID-19



Cases appear by report or onset date - whichever is earliest; therefore case counts may change as new data becomes available.

Cumulative Cases Borough/Census Area Economic Region Acquisition of Disease

Retrieved on 4/15/20 am:  
<https://coronavirus-response-alaska-dhss.hub.arcgis.com/>



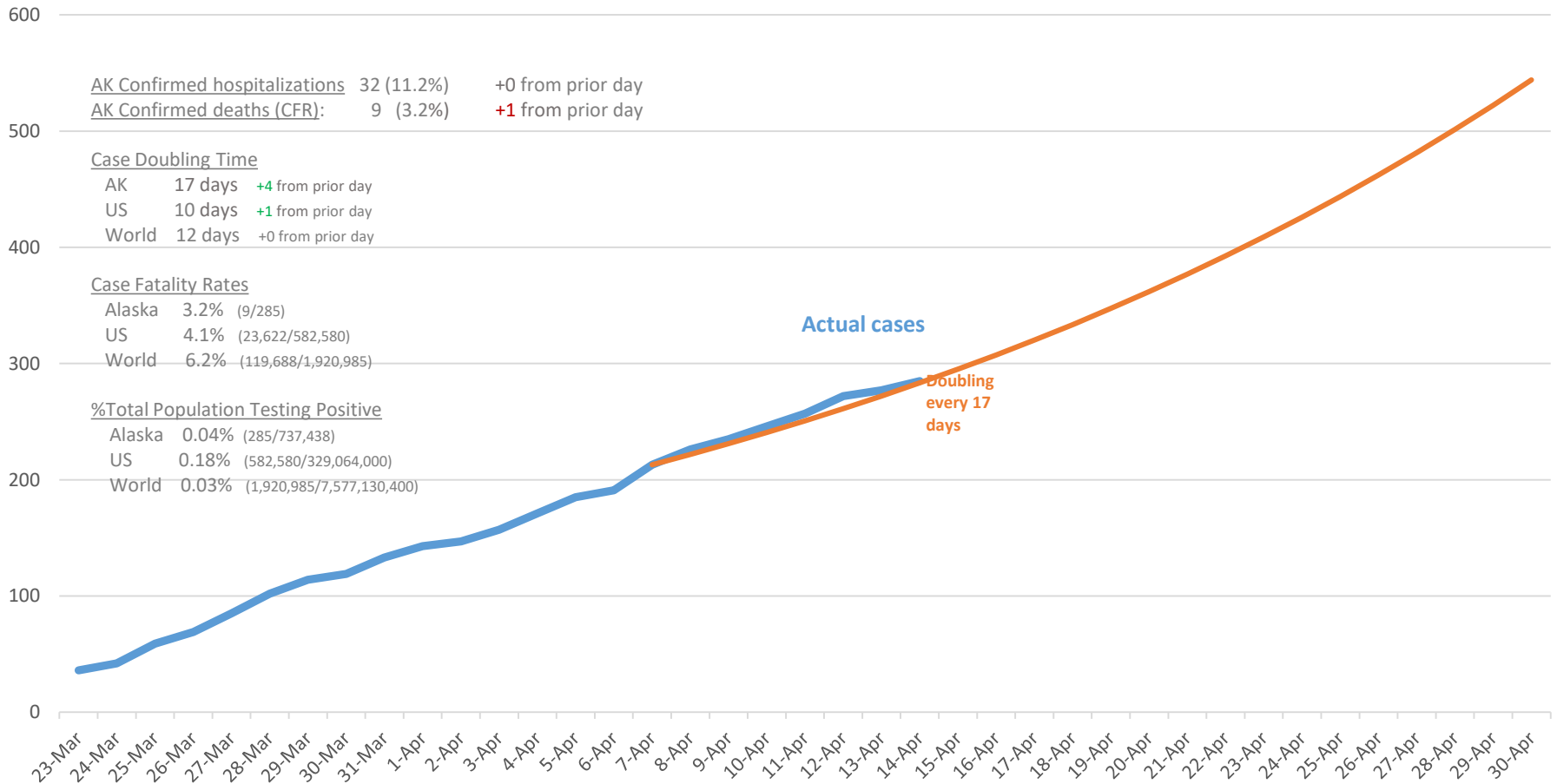
Percent by Age Group Percent by Gender

# Cumulative COVID-19 Confirmed Cases: Actual vs Projected

Doubling About Every 17 days\*

All Alaskans – Statewide

Based on numbers reported on 4.14.20

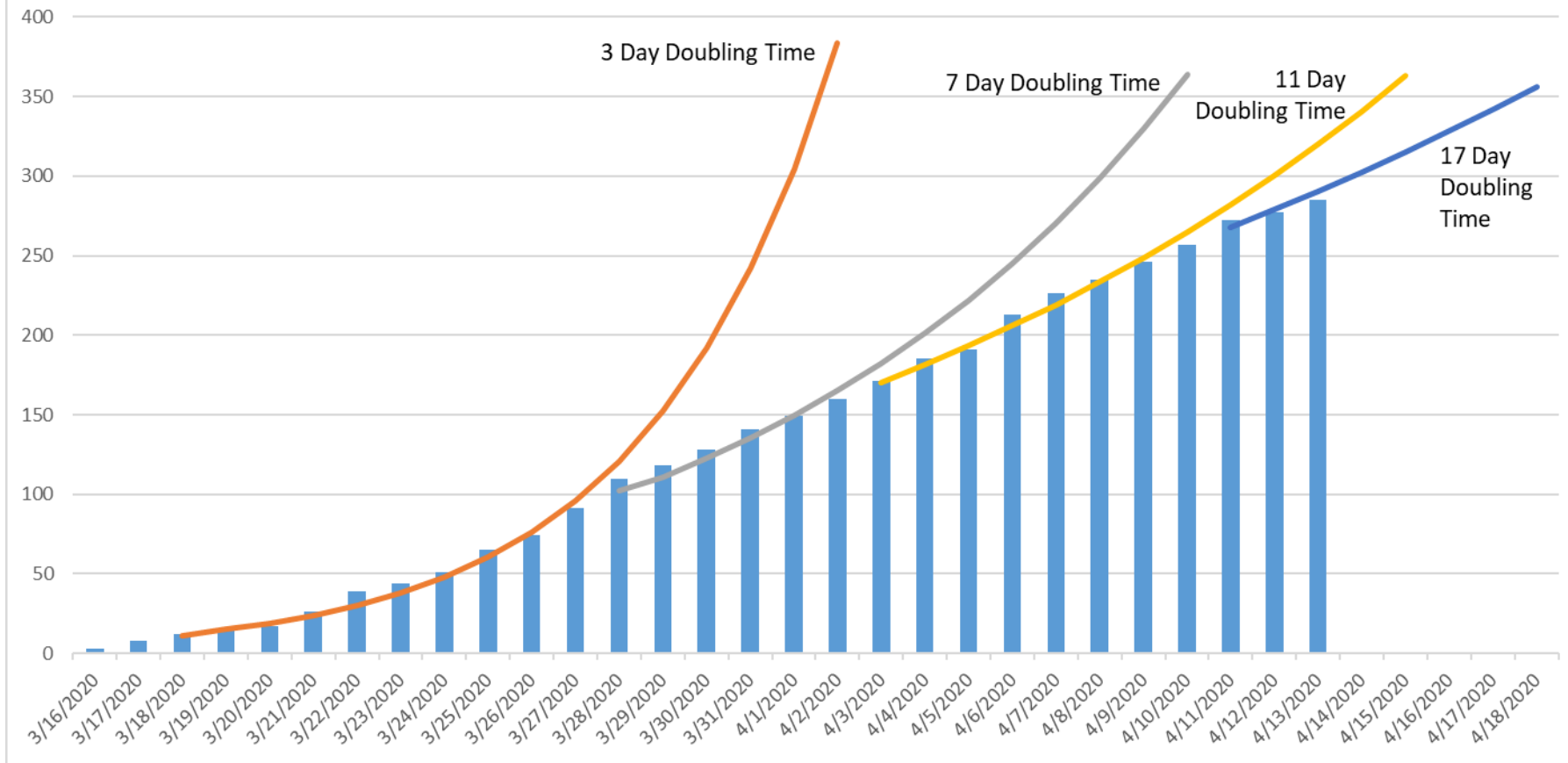


\* Doubling rate is based on **most** recent 8 days from date of this report.

Source of Case Counts (blue): Alaska DHSS <https://coronavirus-response-alaska-dhss.hub.arcgis.com/>; US and World Cases and Deaths from ADN or John Hopkins for Saturdays; <https://www.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>; and total population from <https://worldpopulationreview.com/>; doubling time at <https://ourworldindata.org/coronavirus#growth-of-cases-how-long-did-it-take-for-the-number-of-confirmed-cases-to-double>

# Alaska COVID-19 Cumulative Confirmed Cases

## Doubling Time is Increasing



Created by: K. Black, MS, ANTHC

# Doubling Time is Increasing



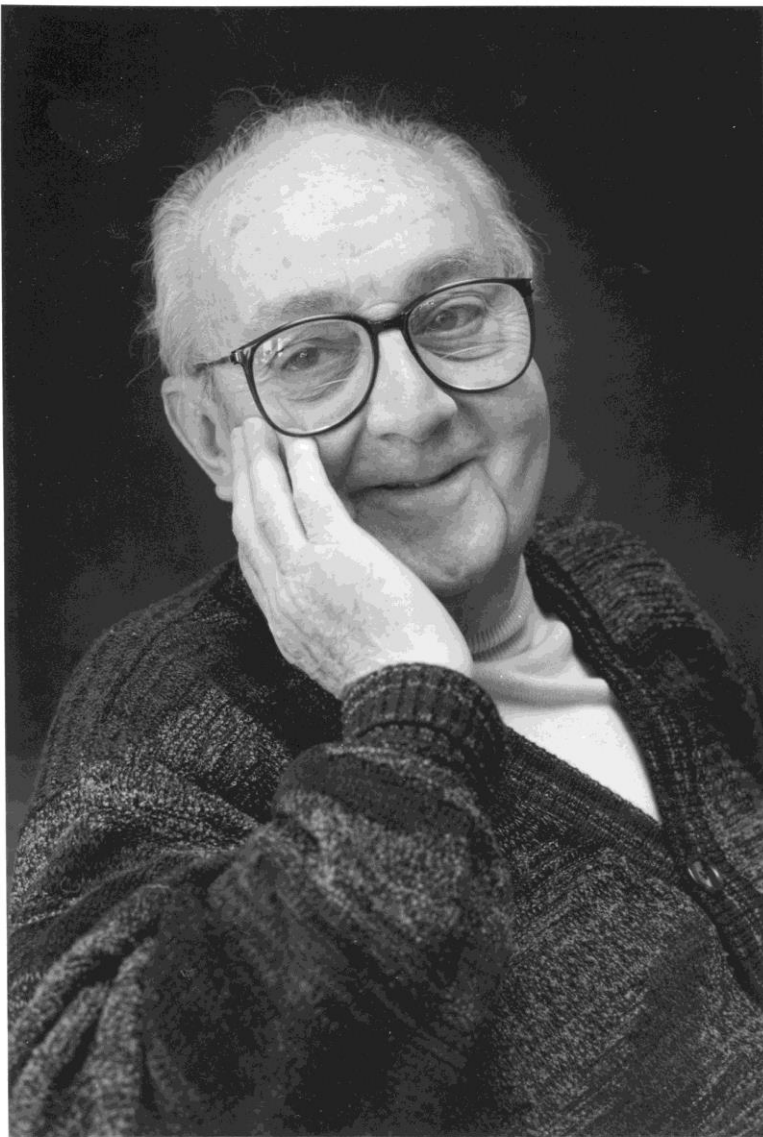
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**“All models are  
wrong;  
but some are  
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*George Box, British statistician*

Photo credit: [https://en.wikipedia.org/wiki/George\\_E.\\_P.\\_Box](https://en.wikipedia.org/wiki/George_E._P._Box)



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Alaska

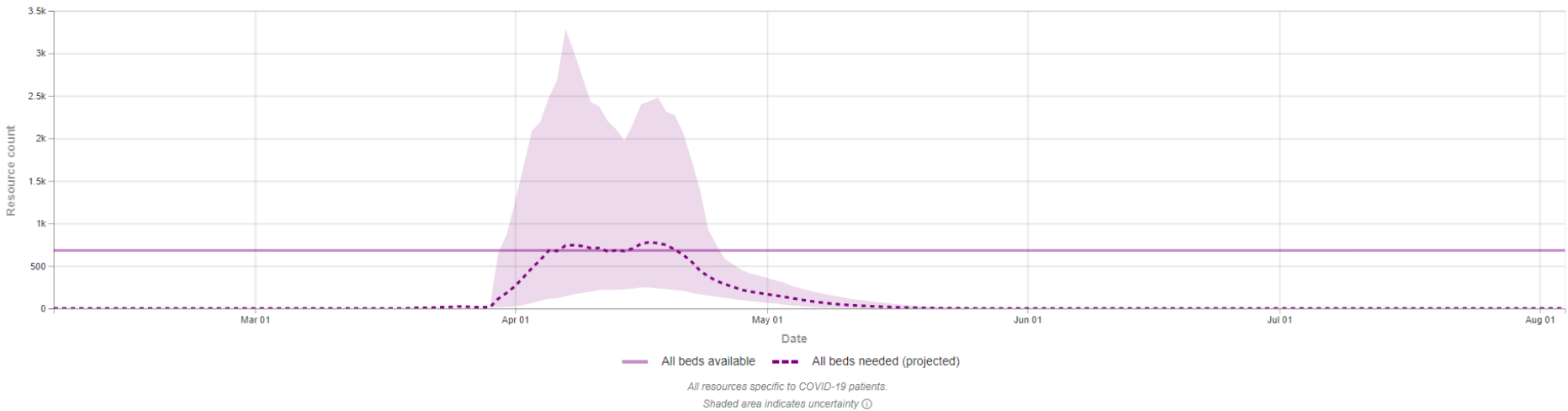
### Hospital resource use ⓘ

10 days until peak resource use on  
**April 17, 2020**

#### Resources needed for COVID-19 patients on peak date

All beds needed <b>780 beds</b>	→	All beds available <b>682 beds</b>	→	Bed Shortage <b>98 beds</b>
ICU beds needed <b>154 beds</b>	→	ICU beds available <b>54 beds</b>	→	ICU Bed Shortage <b>100 beds</b>
Invasive ventilators needed <b>131 ventilators</b>				

All resources All beds ICU beds Invasive ventilators



On 4/7 projected beds needed = 739 (149-3,283)

<https://covid19.healthdata.org/united-states-of-america/alaska>



# Modeling coronavirus: 'Uncertainty is the only certainty'

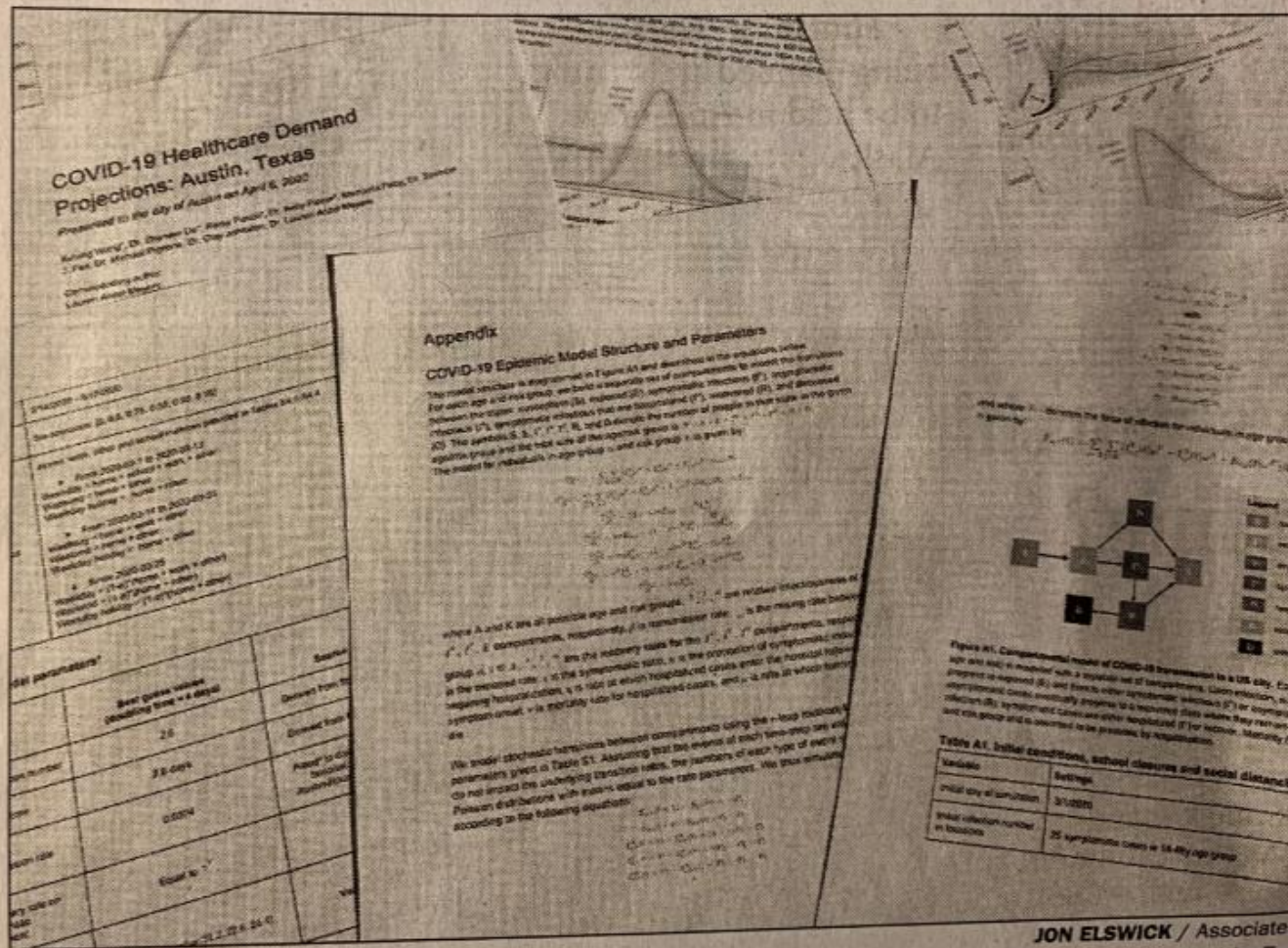
**Seth Borenstein and Carla K. Johnson**  
Associated Press

SEATTLE — A statistical model cited by the White House generated a slightly less grim figure Monday for a first wave of deaths from the coronavirus pandemic in the U.S. — a projection designed to help officials plan for the worst, including having enough hospital staff, beds and ventilators.

The only problem with this bit of relatively good news? It's almost certainly wrong. All models are wrong. Some are just less wrong than others — and those are the ones that public health officials rely on.

Welcome to the grimace-and-bear-it world of modeling.

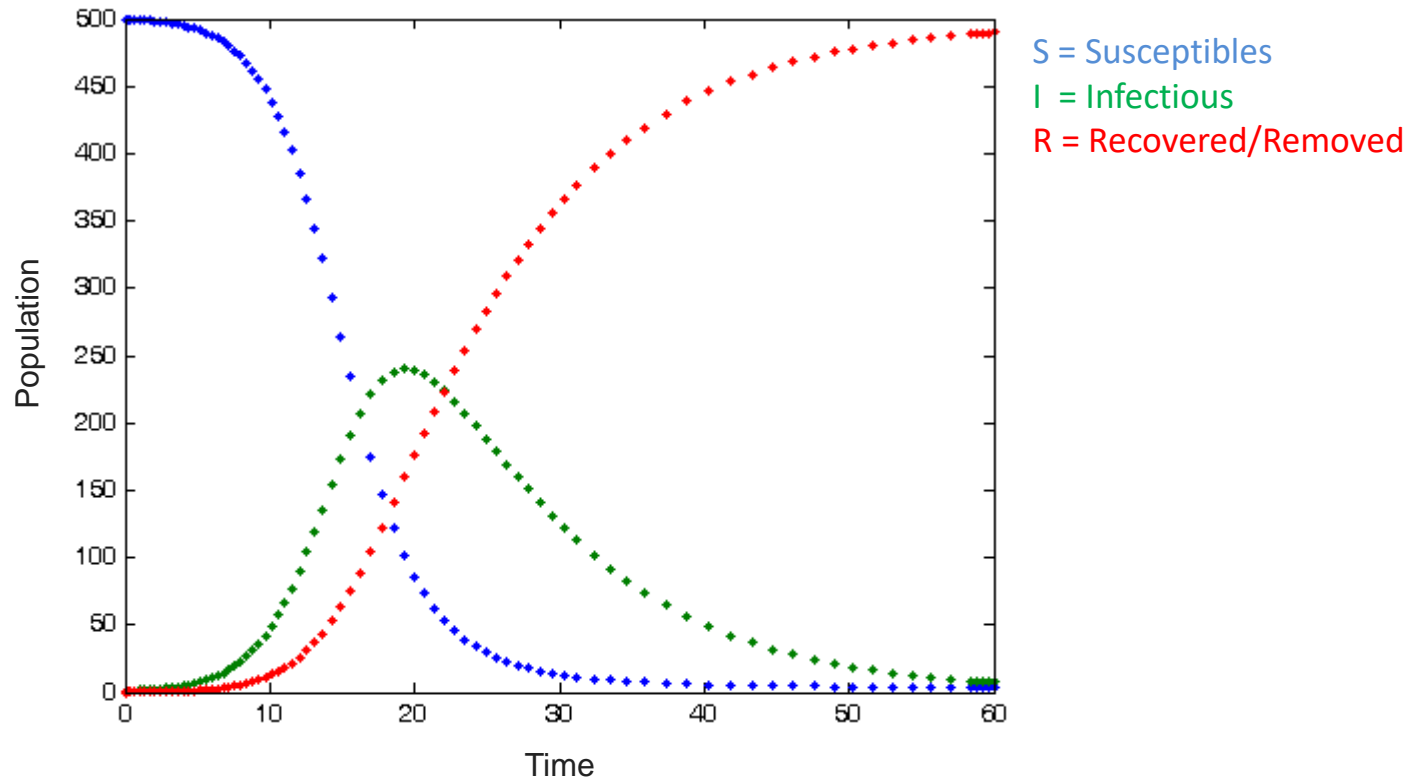
"The key thing is that you want to know what's



A report delivered to the city of Austin, Texas, on COVID-19 health care demand is photographed in Frederick, Md. The latest statistical models forecast fewer deaths in the U.S. from the coronavirus pandemic before August. But there is more uncertainty in those models because health officials are still trying to get a handle on how the virus spreads, how carefully people stick with social distancing and other restrictions, and

# SIR Model

Susceptible-Infected-Recovered



To learn more about SIR models:

<https://www.youtube.com/watch?v=IXkr0AsEh1w>

Source of graph:

<https://en.wikiversity.org/wiki/File:Sirsys-p9.png#/media/File:Sirsys-p9.png>

Basic model for how disease spreads



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# The Importance of $R_0$

- $R_0$  = average number of persons infected by one case
  - $R_0 > 1 \rightarrow$  Disease will spread.
  - $R_0 = 1 \rightarrow$  Disease is stable.
  - $R_0 < 1 \rightarrow$  Disease will decline.
- Estimate of effective  $R$  in Alaska = 1.2
- What impacts  $R_0$ ?
  - Infectiousness of organism
  - Duration of infectivity
  - # of susceptible contacts of infected person
- How to lower  $R_0$ 
  - Block transmission – isolation, social distancing, PPE
  - Vaccines

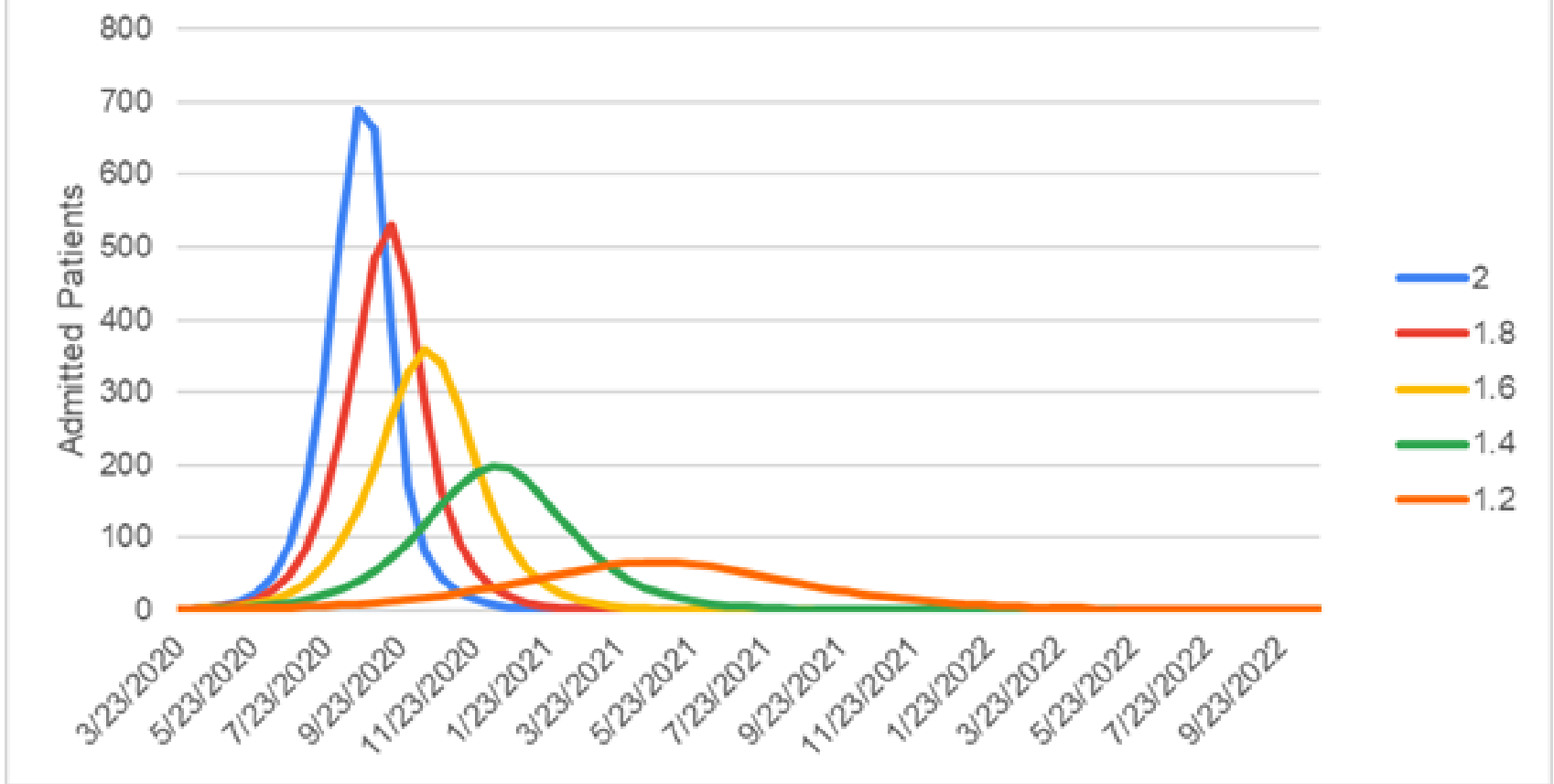
About  $R_0$ : <https://www.khanacademy.org/science/health-and-medicine/current-issues-in-health-and-medicine/ebola-outbreak/v/understanding-r-nought>



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## Greater Urban Area AN/AI COVID-19 Admitted Patients



Approximate ANAI Population Anchorage, Fairbanks, Juneau greater area: 85,237 |

Estimated Hospitalization Rate: 5.4%

Impact of R on height and timing of the peak



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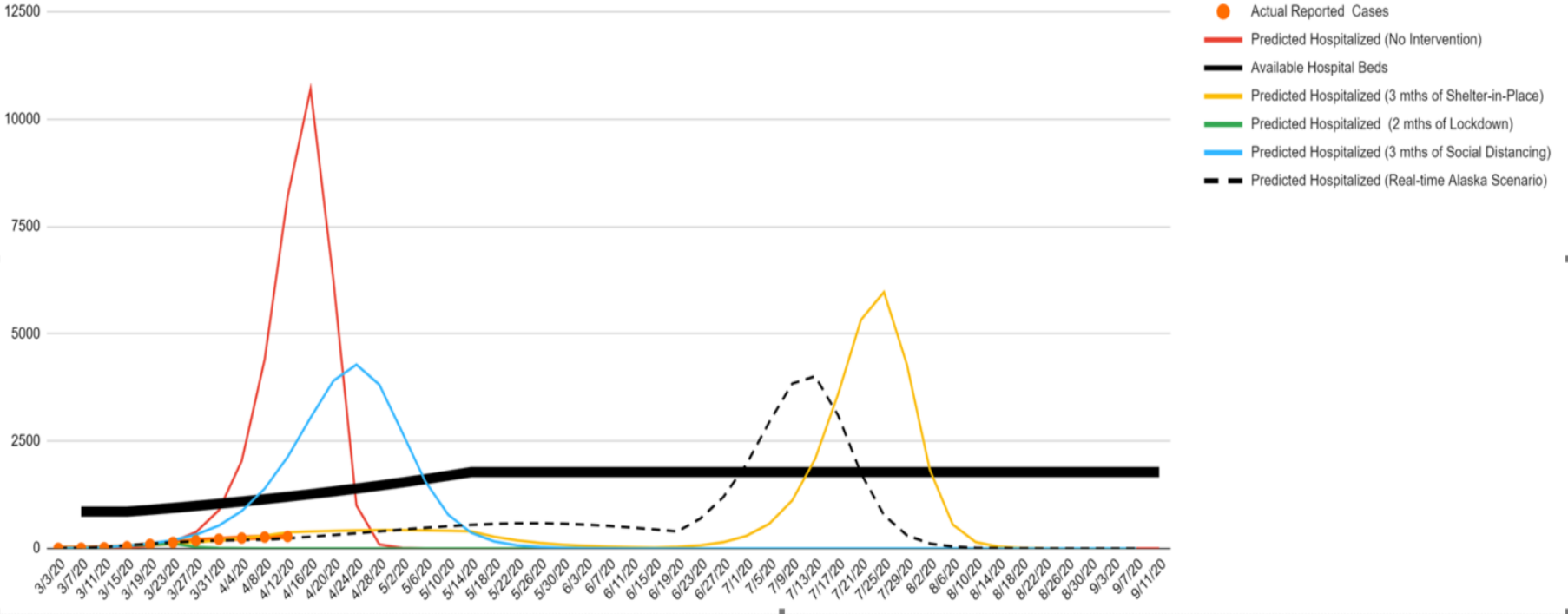




# COVID ACT NOW

Spreadsheet tool that projects new cases, current cases, recovered/deceased, and hospitalizations based on population demographics and disease characteristics.

Predicted Alaska CoVid-19 Cases Needing Hospitalization. No Action vs 3 months of Social Distancing vs 3 months of Shelter-in-place vs Real-time Alaska Scenario



Source: UAA Department of Population Health Sciences

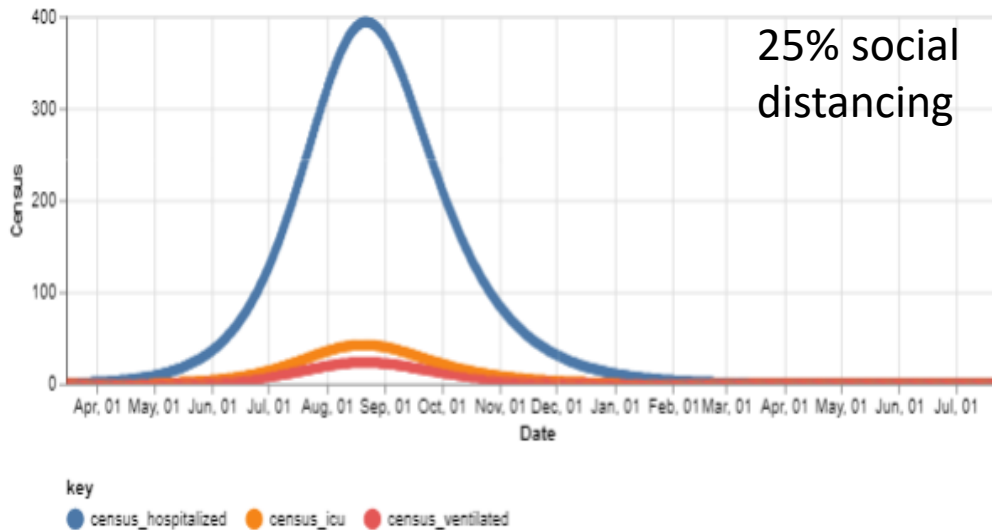
# Penn CHIME

## COVID-19 Hospital Impact Model for Epidemics

Web-based, SIR model based tool for what-if scenarios and projects hospital admission peak beds including ICU peaks and vent peaks.

### Admitted Patients (Census)

Projected census of COVID-19 patients, accounting for arrivals and discharges.



Model Inputs	Value
Regional Population	85,237
Hospital Market Share	100%
Current Hospitalized Covid Patients	0
Doubling Time	8
Social Distancing %	25
Hospitalization % of all infections	5.4%
ICU % of all infections	0.78%
Ventilated % of all infections	0.39%
Infectious Days	14
Average Length of Stay	12
Average ICU Days	9
Average Ventilated Days	10
Number of Days to Project	500
Current Date (model start date)	3/16/2020

For AN/AI people in the greater Anchorage, Fairbanks, Juneau areas:

*Interpret with caution due to uncertainty:*

**if 25% social distancing, projects estimate of 394 beds needed at peak in late August**

# Other Models

- UT Austin – more simulation based
- HySE Bed Demand Model
  - is a 4 week capacity planning tool for beds, ICU beds, and ventilators requirements for COVID and Non-COVID patients. - includes
- <https://www.hsye.org/covid-19>
- CDC COVID19Surge – beta testing



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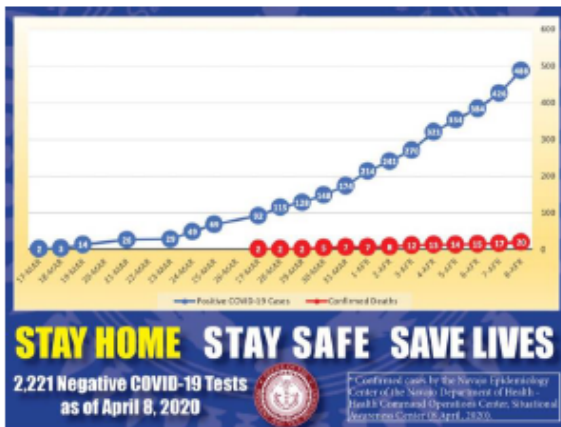
# What's next?

- Collaborating with the State, UAA, to build/test a more sophisticated SIR model based on AK observations
- Built and evaluating a model for potential impact of THO regions on ANMC
- Expect changes in social policy that will impact these projections
- More data, better models



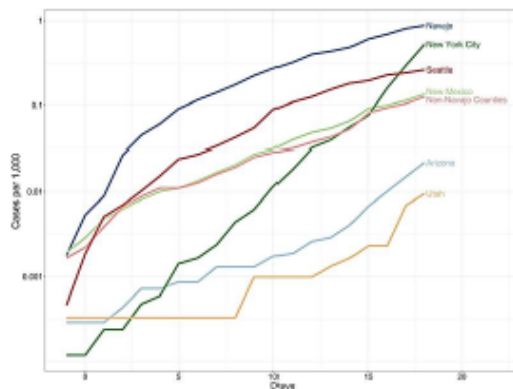
## Initial Data from Navajo Nation Highlights the Critical Need for the Alaska Tribal Health System to Prepare for COVID-19

The Navajo Nation is in crisis. As of April 8, 2020, the Navajo Nation had 488 positive cases of Dikos Ntsaaígíí-19 (COVID-19).<sup>i</sup> The Navajo Nation has several similarities to the Alaska Tribal Health System including communities with a lack of running water (currently 33 Alaskan communities are underserved by water and sewer) and large numbers of tribal members with high risk factors for severe illness related to COVID-19. The data available for case count, hospitalization, and deaths from the Navajo Nation along with information about pre-existing conditions underscores the critical need for the Alaska Tribal Health System to adequately prepare our response to COVID-19.



### Navajo Nation Higher Per Population Case Count

The rate of COVID-19 cases in Navajo counties is higher than in New York City, Seattle, and the surrounding non-Navajo counties. The line graph to the right shows the cases per population over time starting from the day the first case was diagnosed in each region, with cases per 1,000 population presented on a logarithmic scale.<sup>ii</sup>



### Navajo Nation Higher Hospitalization and ICU Care Rates

Initial data **suggests** that Navajo Nation citizens required hospitalization and ICU care at higher rates than the general US population. There might be multiple factors that could explain the data.

- As of March 31, 2020 there are 148 cases in Navajo Nation. Of the 148 cases, 49% are within the Kayenta Service unit (KSU) and 16% within the Chinle Service Unit (CSU). Kayenta Service Unit has been most impacted by the pandemic where **almost half of the cases have required hospitalization (48%)**.
- **About 50% of those hospitalized appear to have required ICU level of care** (estimate extrapolated from reports from KSU and CSU emergency physicians transferring patients from the ER to tertiary care centers)<sup>iii</sup>

Alaska Natives are at Higher Risk due to Pre-Existing Conditions



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# Review

- COVID-19 in Alaska
- General Predictive Modeling Concepts
- What do the models say?
  - COVID ACT NOW
  - UPenn CHIME
  - Others
- What's next?



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- **Syndromic Surveillance**



# Syndromic Surveillance is...

“... an investigational approach where health department staff, assisted by automated data acquisition and...statistical signals, monitor disease indicators continually (real-time) or at least daily (near real-time) to detect outbreaks of diseases earlier and more completely than might otherwise be possible with traditional public health methods...”

Centers for Disease Control and Prevention Framework for evaluating public health surveillance systems for early detection of outbreaks: recommendations from the CDC working group.  
MMWR Recomm Rep. 2004;53:1-11



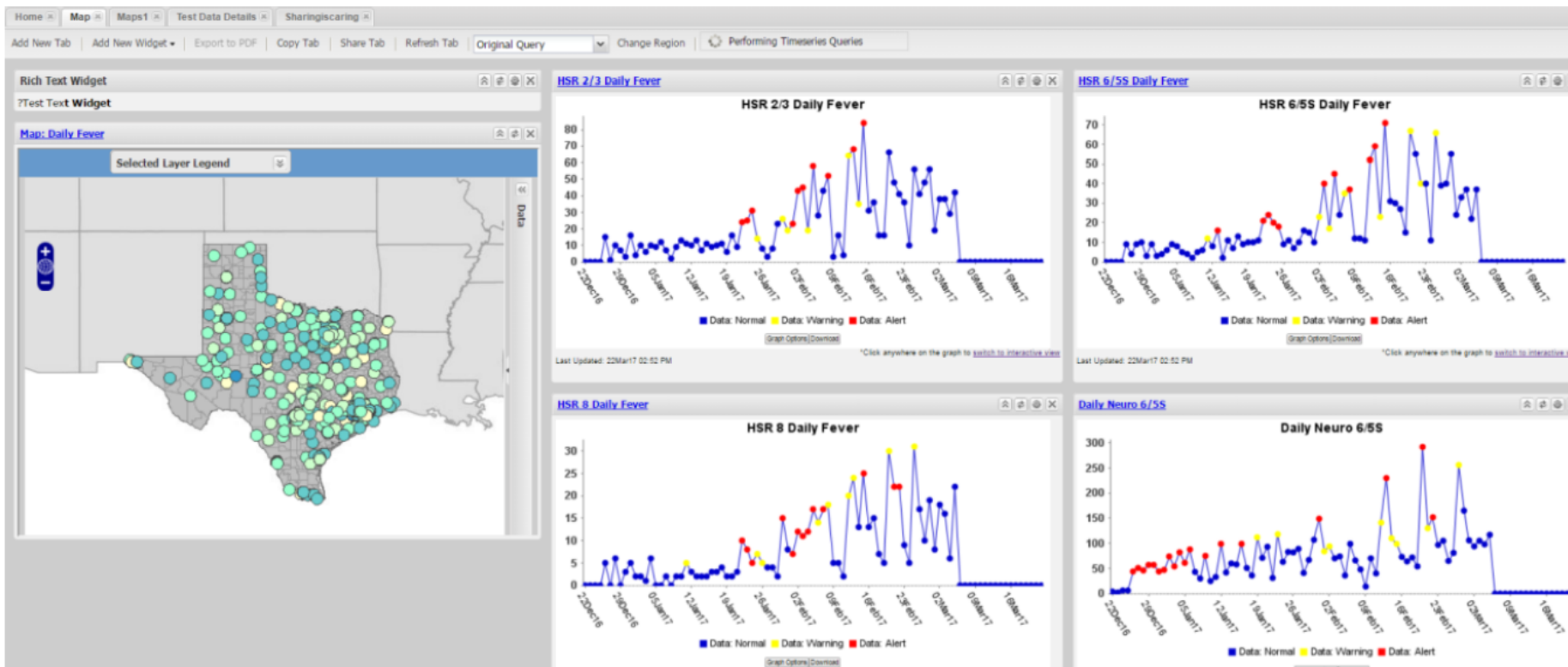
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# Partners

- Tribal Health Organizations
- Other Health facilities
- Section of Epidemiology, Alaska Department of Health and Human Services
- Centers for Disease Control and Prevention
- National Syndromic Surveillance Program and their a Community of Practice

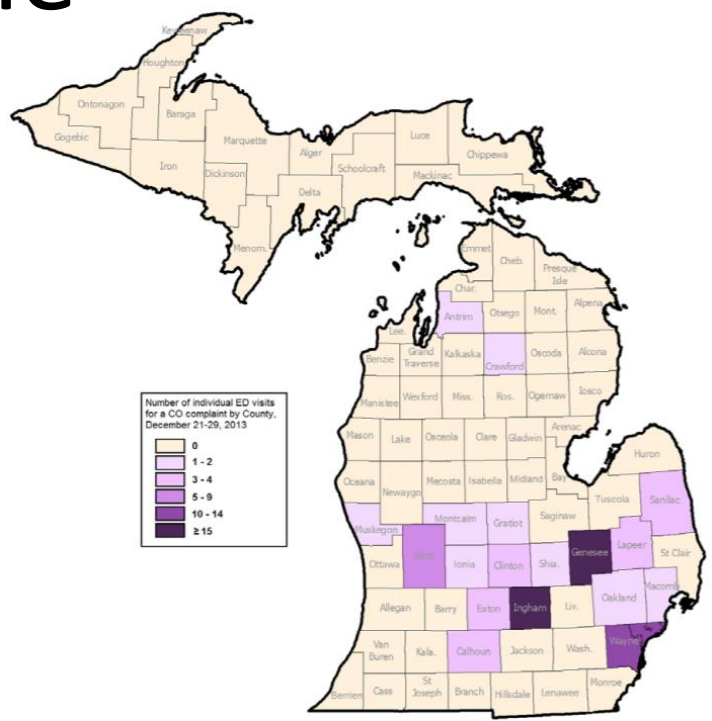
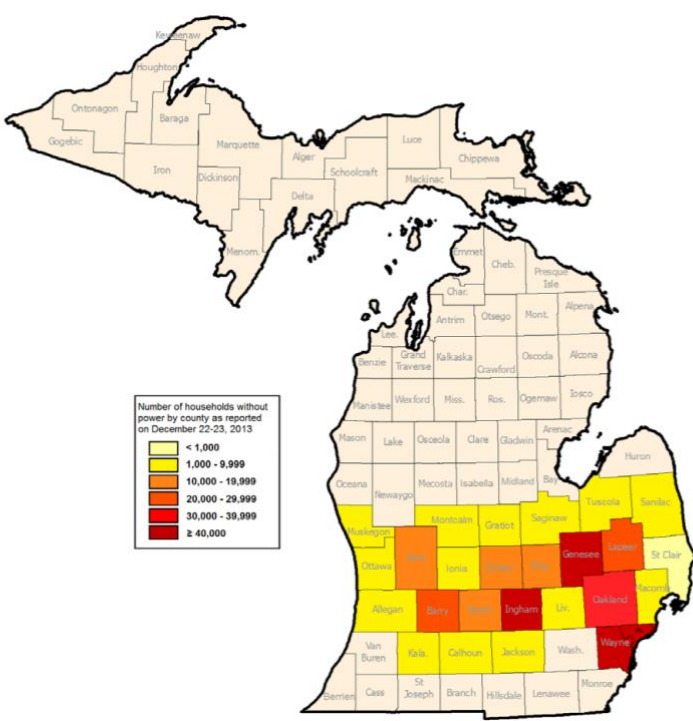


# Example

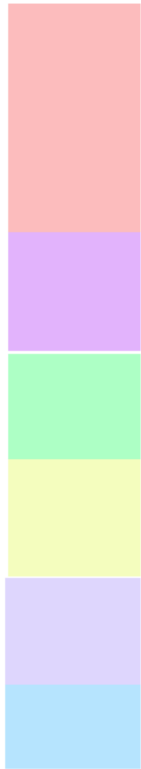


Texas Syndromic Surveillance User Guide (May 2018). Texas Department of Health Services, Austin, TX. <https://www.dshs.texas.gov/>:

# Example



Mamou F, J Fiedler, and L. Cameron. 2014. Real-time carbon monoxide (CO) surveillance during an ice storm event in Michigan- December 21-29, 2013. Poster presented at Annual Meeting of the Council of State and Territorial Epidemiologists, June 22-26, Nashville TN.



**Anchorage**

**Mat-Su**

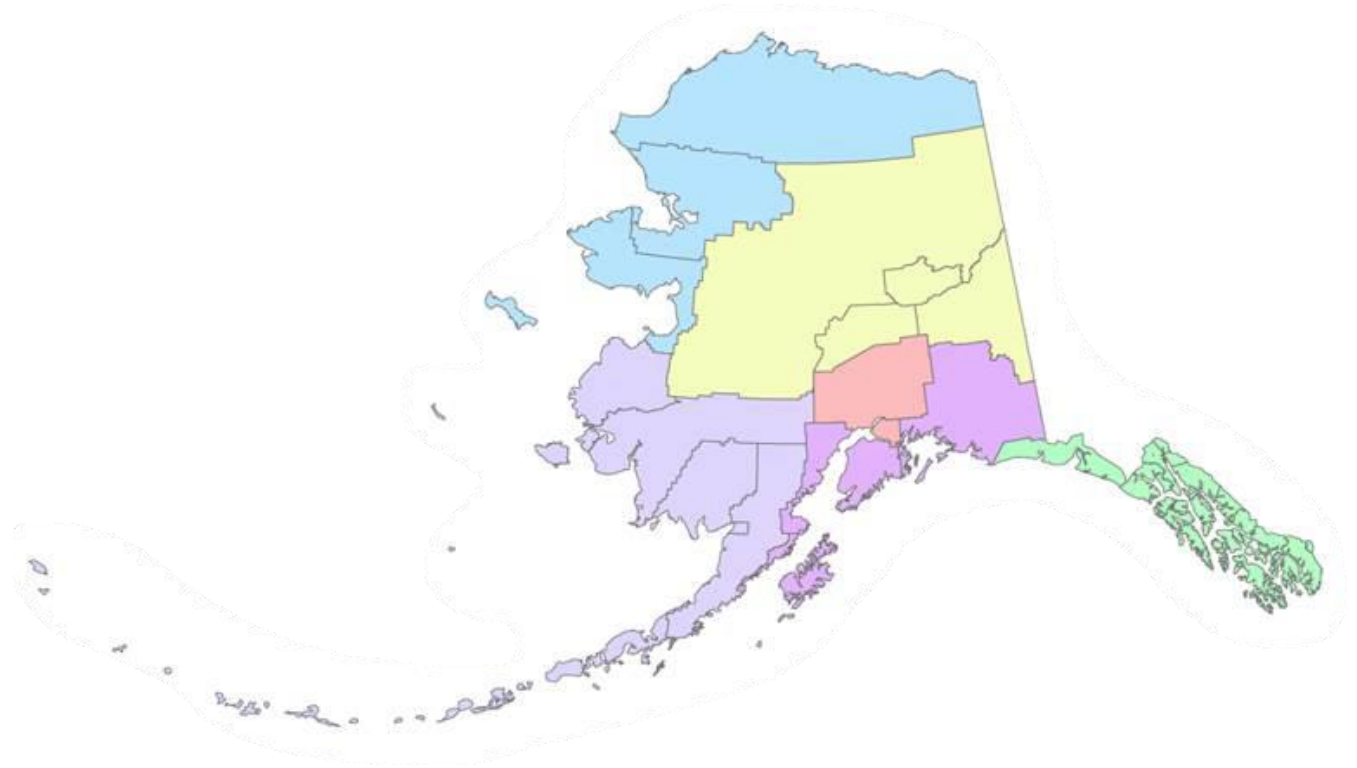
**Gulf Coast**

**Southeast**

**Interior**

**Southwest**

**Northern**



Regional Map: Alaska Department of Health and Social Services. , <https://gems.dhss.alaska.gov/FileManager/GetFile/609cd015-56cb-e811-a95f-005056ae3533>



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